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# Marine Engineering

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## THE BARCELONA DEPOSITING DOCK.

In view of the importance of Barcelona as practically the center of Spain's commercial life, it is surprising to find that it has only recently been provided by the port authorities with a dock capable of dealing with the many thousands of tons of shipping frequenting the port annually. After considerable discussion by the harbor board on the merits of various forms of docks laid before them, they finally decided on adopting the design of Messrs. Clark and Standfield, of London, which provided for a depositing floating dock, which, as shown by the following description and illustrations, is an ingenious combination of pontoons and staging, completing an arrangement which enables several vessels to be repaired at the same time.

BARCELONA DEPOSITING DRY-DOCK, SHOWING ONE VESSEL ON THE GRID AND ANOTHER ON THE DRY-DOCK.

The dock is of the single-sided type, attached by hinged booms to a floating outrigger; but instead of the pontoon or platform being a continuous caisson, it is divided up into separate fingers, each attached to the wall of the dock. Similar fingers to correspond with the spaces between the dock fingers, and built up of piles, are erected along the fore shore, and when the vessel has been raised on the dock the whole dock with the vessel on it is warped in between the fingers on to the grid. The dock is then lowered, the vessel remaining deposited high and dry on the grid, and the dock then withdrawn, ready to pick up and deposit other ships if required.

It will be seen, therefore, that the construction of each grid of the same length as the dock is equivalent to doubling the capacity of the dock, and, if space is available, this forms a very cheap way of obtaining a large amount of docking accommodation. Of course, where only one vessel requires docking, the dock can be used as an ordinary floating dock, without the use of the depositing staging.

Such a dock is especially adapted to the port of Barcelona, first, because of the absence of the tide, which enables the dock to deposit vessels at all hours, and, second, because there being no dock of any kind in

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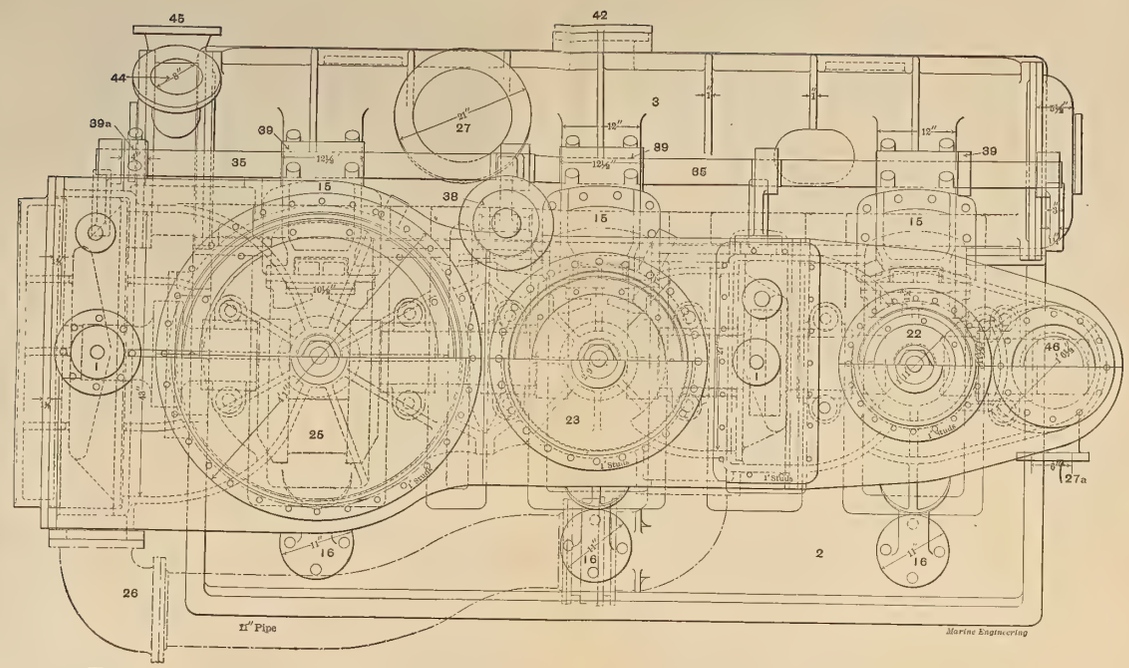
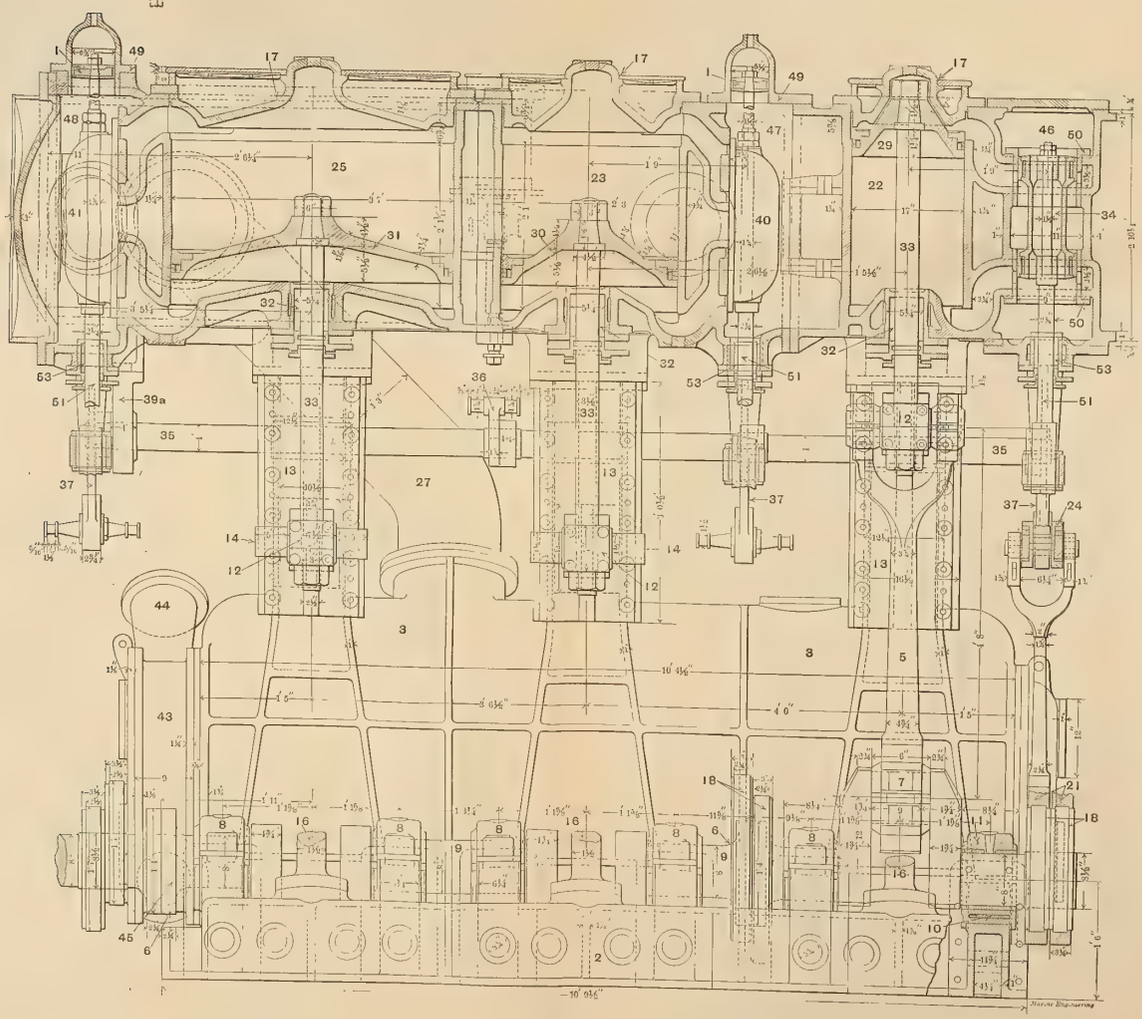
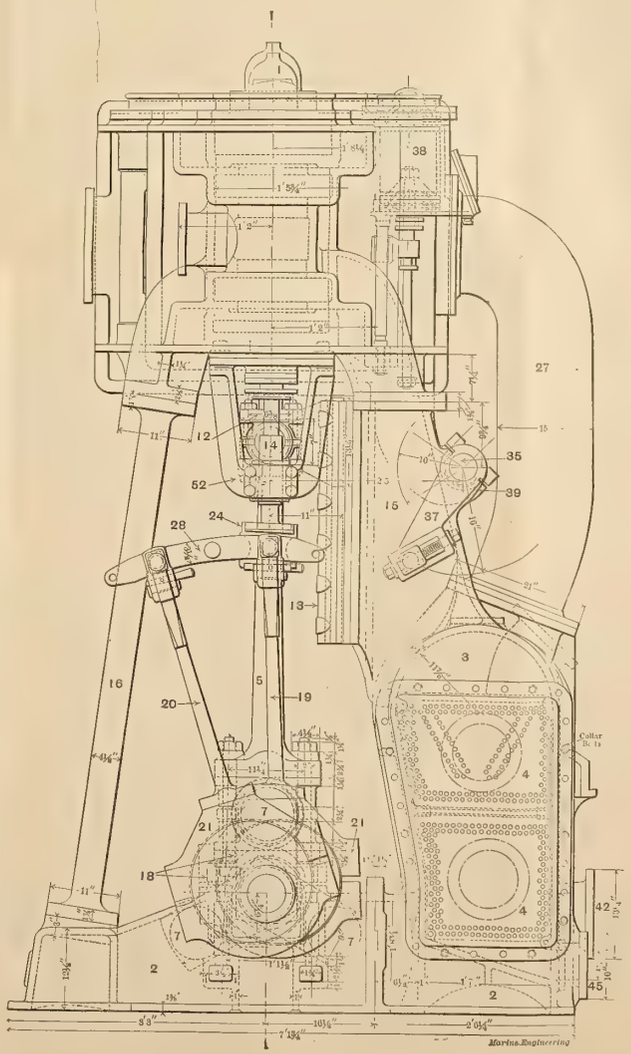



KEY TO DRAWINGS.

1 Balance pistons.
2 Bedplate.
3 Condenser.
4 Condenser tubes.
5 Connecting rod.
6 Couplings.
7 Crank pins.
8 Crank shaft bearings.
9 Crank shaft.
10 Crank shaft brasses.
11 Crank shaft cap.
12 Crossheads.
13 Crosshead guides.
14 Crosshead pins.
15 Cylinder columns, cast iron.
16 Cylinder columns, forged steel.
17 Cylinder covers.
18 Eccentrics.
19 Eccentric rod, go-ahead.
20 Eccentric rod, astern.
21 Eccentric straps.
22 High-pressure cylinder.
23 Intermediate-pressure cylinder.
24 Link blocks.
25 Low-pressure cylinder.
26 Low-pressure receiver.
27 Main exhaust pipe.
27a Main steam pipe.
28 Main links.
29 Piston, high-pressure.
30 Piston, intermediate-pressure.
31 Piston, low-pressure.
32 Piston-rod stuffing boxes.
33 Piston-rods.
34 Piston-valve, high-pressure cylinder.
35 Reverse shaft.
36 Reverse shaft arm for reversing engine.
37 Reverse shaft arm for links.
38 Reversing cylinder.
39 Reversing shaft bearings.
39a Reversing shaft bracket.
40 Slide valve, intermediate-pressure cylinder.
41 Slide valve, low-pressure cylinder.
42 Suction pipe connection from condenser to air pump.
Suspension links, not shown, connect Nos. 28, 37.
43 Water chest of condenser.
44 Water chest discharge for circulating water.
45 Water chest intake for circulating water.
46 Valve chest, high-pressure cylinder.
47 Valve chest, intermediate-pressure cylinder.
48 Valve chest, low-pressure cylinder.
49 Valve chest covers.
50 Valve chest liners.
51 Valve stems.
52 Valve stem guides.
53 Valve stem stuffing boxes.






THREE-CYLINDER, INVERTED, DIRECT-ACTING TRIPLE-EXPANSION ENGINE.

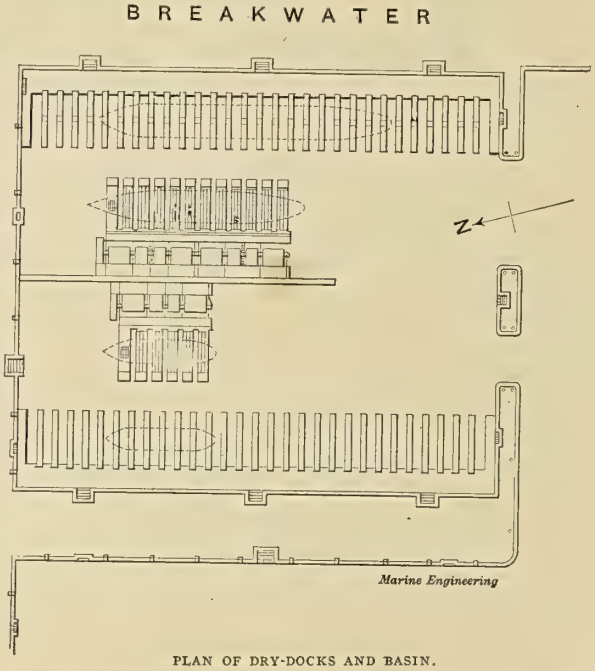
FOR DESCRIPTION SEE PAGE 351.

Barcelona, which is a large shipping port, there is far more work than could be handled by a single dock. One of the projects considered was for three dry-docks, the cost of a single one of which would have been more than this depositing dock, which has a lifting power of 6,000 tons. The dock works normally in two sections, which are arranged so as to lift vessels displacing 4,000 and 2,000 tons respectively. There is also a hinged joint by which these two sections can be coupled together in fifteen minutes, so as to lift a ship of 6,000 tons. The largest section is also divided into two equal parts connected by a bolted joint, which can be unmade to allow the two parts to be used to lift one another for self-docking; while of course the smaller section can be docked on the larger, thus enabling any part of the whole dock to be got at for the purposes of repair.

On the next page is shown how one section of the dock may be lifted by another section. This self-docking system is one of the distinctive characteristics of the different types of floating docks turned out by the designers. It naturally allows the life of the structure to be indefinitely prolonged, and if carefully looked after may be considered as lasting as a graving dock.

The machinery for working the dock is designed to lift a ship of the maximum weight in 1 1-2 hours, and was constructed by the builders of the hull of the dock, namely, the Maquinista Terrestre y Maritima of Barcelona. There are also provided on the sections hauling engines and gear for moving the dock back and forth to the grid.

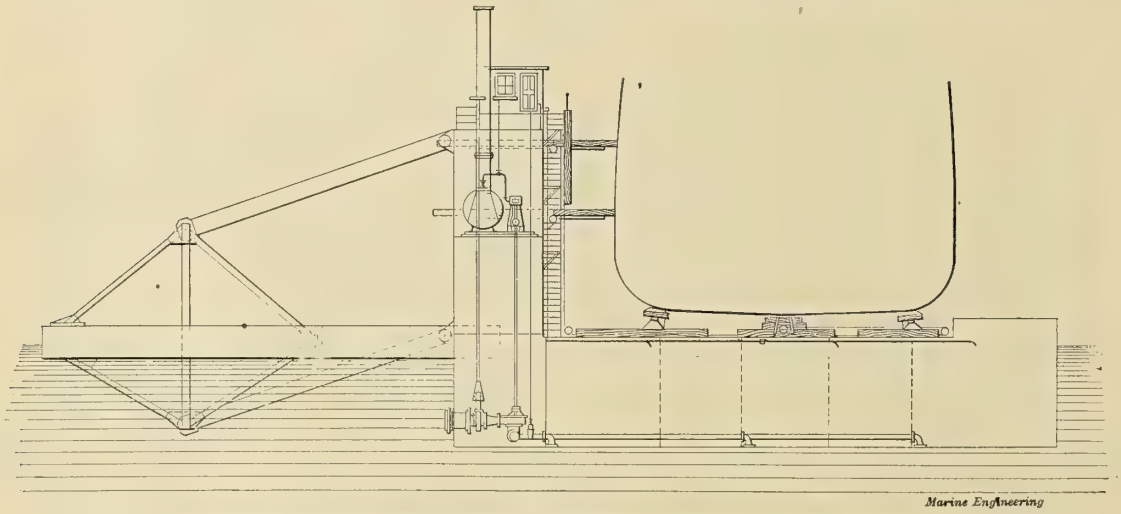
other suitable for vessels up to 6,000 tons. Thus the docking capacity in numbers and length of vessels may




PLAN OF DRY-DOCKS AND BASIN.

be considered to be equal to the length of the grids plus the length of the dock.

A comparative novelty has been fitted to this dock,




CROSS SECTION OF BARCELONA DRY-DOCK. DESIGNED BY MESSRS. CLARK AND STANDFIELD.

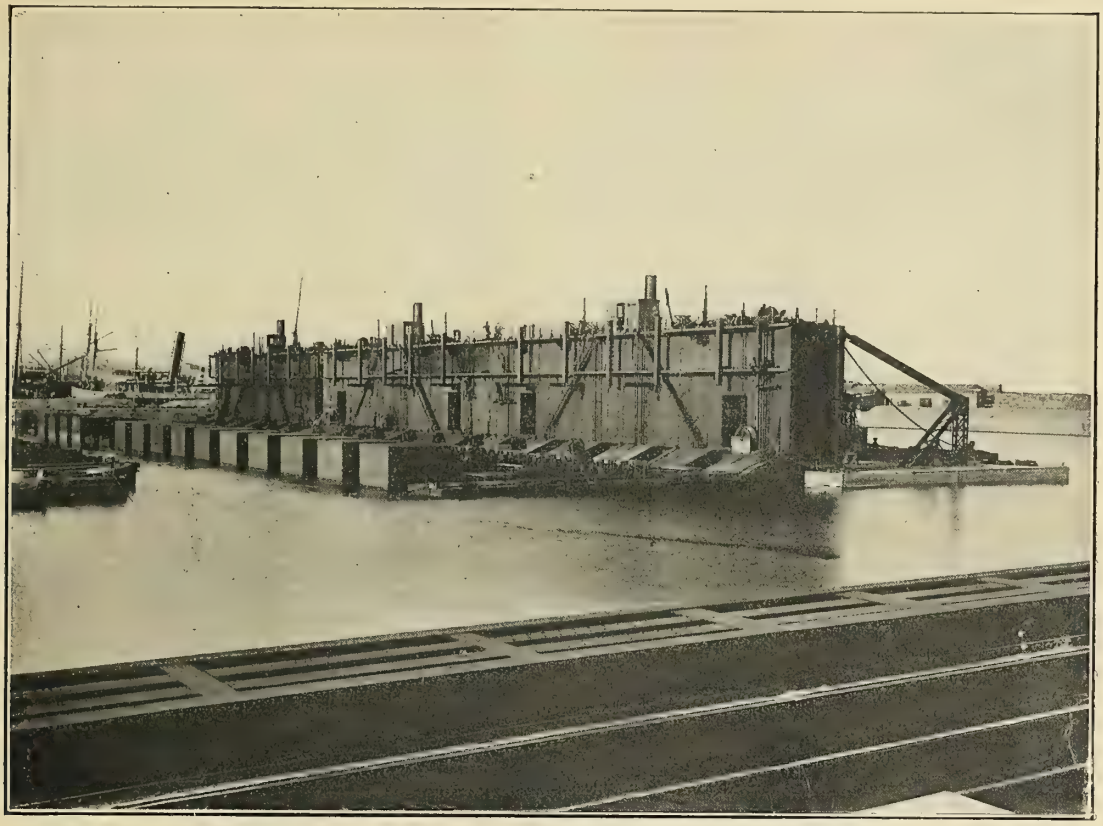
At the recent official trials in January last the *Ciudad Condal,* one of the fleet of the Compania Transatlantica, was successfully lifted and deposited, this trial being particularly gratifying in view of the fact that this vessel was over 40 feet longer than the section of the dock by which it was lifted and deposited.

As installed at Barcelona, the two sections are placed in the middle of the basin, back to back with the third section. On each side of the basin opposite the docks are two grids, each 650 feet long, the one built to take light vessels up to 2,000 tons displacement, and the

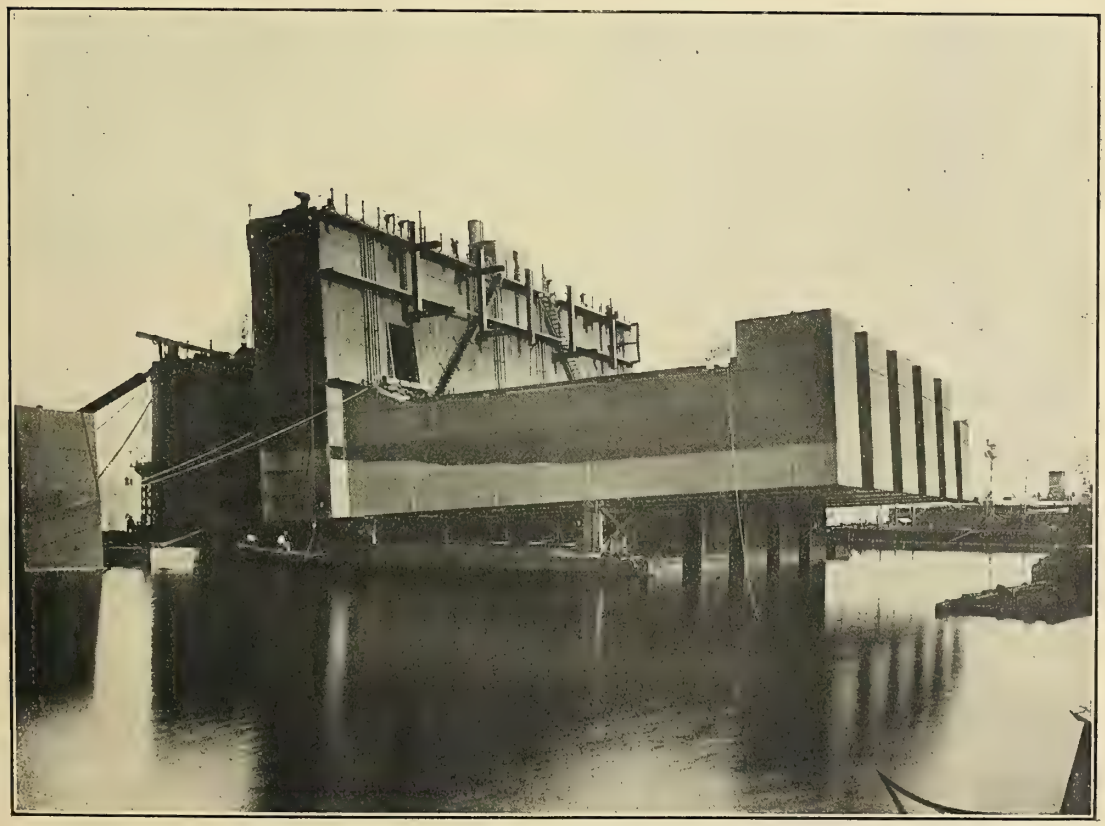
which proved of the greatest use in depositing vessels; this consists of indicators connected with each of the compartments of the dock, showing in the valve house the exact height of water in every compartment.

The length of the whole dock is 360 feet, that of each section being 120 feet, and the width of entrance 75 feet, although the dock being a single-sided one this dimension is not the absolute maximum.

At Barrow, in England, and Vladivostok and Nocolaiev, in Russia, similar docks by the same designers have proved conspicuously successful for many years past.



CENERAL VIEW OF DRY-DOCK.



BARCELONA DRY-DOCK, ONE SECTION BEING DOCKED BY A SECOND SECTION.

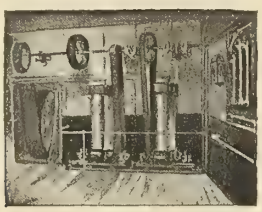
## USES OF ELECTRICITY ON BOARD SHIP.—I.

BY J. W. KELLOGG.

### EARLY INSTALLATIONS.

Since the first installation of incandescent electric lights their adaptability for ship use has been apparent, and as the applications of electricity have been extended it is shown to be ideal for transmission of energy for all purposes on shipboard. It is interesting to follow this development. The first electric plant that was ever put into operation in the hands of strangers was on the steamship *Columbia,* and was installed under directions from Mr. Edison. In a report dated February 24, 1882, Mr. J. C. Henderson, who was at that time advising engineer of the Oregon Railway and Navigation Company, states that in the summer of 1879, while the *Columbia* was under construction, he wired the ship for electric lights; the plant was started on the 2d of May, 1880. There were 115 lamps installed, and No. 11 wire was used for mains and No. 32 wire for the loops, insulated by double-paraffined cotton, and painted over all. The report states that the wires were run throughout the entire vessel, but lights were only placed in the passengers' rooms and the main saloon. The engineer of the vessel stated that 115 lamps were operated over four hundred hours without one lamp giving out. Two years after the plant was started it was reported that from the time of starting until that day the plant had operated to the entire satisfaction of the company under all circumstances.

From 1880 to 1882 there was very little done in steamship work, but early in the latter year the Edison Company installed a plant on the *Queen of the Pacific* and on Mr. James Gordon Bennett's steam yacht *Namouna.* The former plant was installed as the result of the success of the one on the *Columbia.* The next we hear is of the light being used on the Russian steamers plying

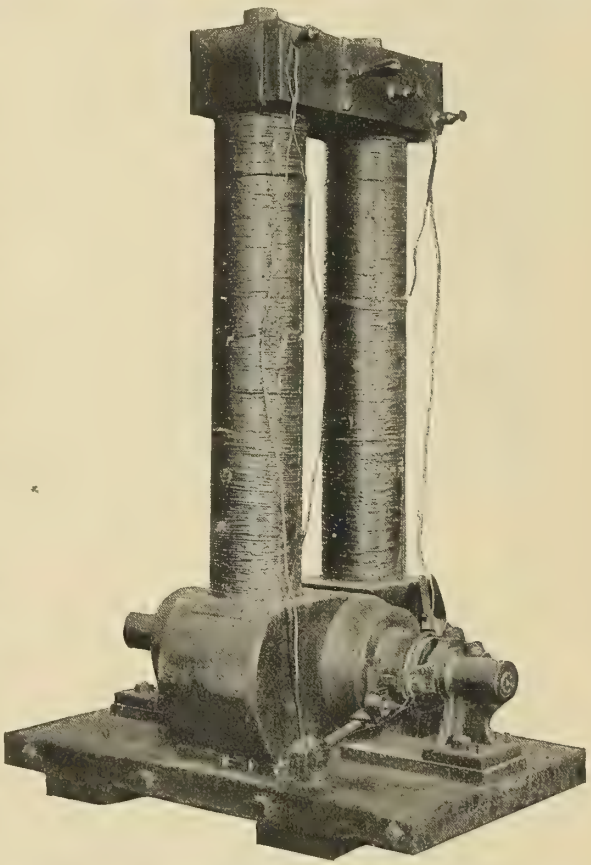


DYNAMO ROOM, STEAMER COLUMBIA.

the river Volga in the summer of 1882. There is a description of the *Queen of the Pacific* in one of the early bulletins of the Edison Company, showing 146 lamps to have been installed. The circuits were so run that any individual lamp could be controlled. Switches were placed under the direction of the steward, one switch controlling all lamps forward of the engine room, another saloon, dome, and shaft alley. The lamps were arranged to screw into a socket in the ceiling of each state room, and the wires were led in such a way as to be concealed. The last of July, 1882, it was reported that the plant on the yacht *Namouna* operated without accident on a voyage across the Atlantic.

During this summer plants were also installed on the Long Island Sound Norwich Line steamer *City of Worcester,* and on the steamer *Carolina,* of the Baltimore Bay Line. Later in the fall a plant was ordered for the steamer *Virginia,* of the latter line, and for the *Albatross,* of the United States Fish Commission. Of 22,000 lights installed up to October, 1882, 2,000 of them had been placed on steamships.

In December, 1882, an order was given for a plant of 120 lights for the steamer *Kate Adams,* running on the Mississippi river. About the same time the English Edison Company received an order for plants for two ocean steamships for the Ocean Steamship Company of New Zealand. The first one, the *Tarawera,* was thrown open to the public in December, 1882. This was the first



EDISON BIPOLAR DYNAMO, CAPACITY 60 10-C. P. LAMPS, INSTALLED ON S. S. COLUMBIA IN 1880.

English vessel on which the Edison system had been applied. There were 150 lamps with an L type of machine, driven by three-cylinder Brotherhood engine. The captain stated that the electric plant on this vessel worked well throughout the voyage from Greenock, Scotland, to Melbourne, Australia.

Early in 1883 a plant was ordered for the steamer *Carolina,* of the Oceanic Steamship Company of San Francisco, running between San Francisco and the Sandwich Islands. In a report of the collision between this steamer and the *Riverdale,* the captain of the *Carolina* said (January, 1883): "We had a most satisfactory demonstration of the working of the Edison electric lights, which were only extinguished in the damaged part of the boat, thus removing all cause of fire, which would have been certain had any other method of lighting been employed."

The description of the plant on the steamer *Pilgrim*

in April, 1883, shows that there were 910 lamps installed, the current for operating being generated by one L and two K dynamos, driven by two Armington and Simms engines belted direct to the dynamos. Steam was furnished from a special boiler at 80 pounds pressure. Connections were also made with the ship's donkey and main boiler, to be used in cases of emergency. The dynamos were arranged to be used together or separately, and regulated by an Edison regulator. Current was taken from the dynamo room to the main deck through Edison tubes; these ran vertically on the forward side and there divided to each side of the boat. Each branch ran aft to the center of the boat and from there was run vertically to the ceiling of the galley deck. It was the intention to provide a system that would prevent the lamps being extinguished by an accident, each section being independent of the other.

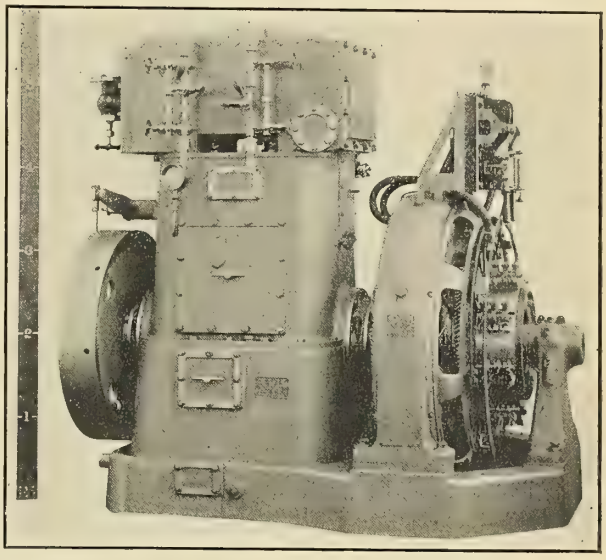
In June, 1883, the London Edison Company installed a plant on the steamship *Oregon,* which was building at Glasgow for service between Liverpool and New York; and on the steamer *Rio Pardo,* for the Brazilian coasting trade. In the bulletin of May 31, 1883, the Edison Company reported twenty-four plants on steamships, aggregating 4,850 lights. The first steamship of the United States Navy to be electrically lighted was the *Trenton;* in August, 1883, 150 lights were installed.

In part, a report of the chief engineer of the *Albatross* is as follows: "There are 139 8-c.p. lamps placed in multiple arc and so distributed throughout the vessel as to illuminate every place where light is desired. There are four circuits, viz., a double circuit on each side of the ship for the forward lamps; a double circuit on each side of the ship for the after lamps; a single independent circuit for the outside lamps, with switch in the engine room; and an independent circuit for the engine room. The mains are not only double circuits, but each consists of two No. 10 wires. The advantage of this system of wiring is manifest, as, in the event of breaking a wire from collision or other cause, the remaining wires will be ample to carry the current. The mains, however, are brought together and soldered where they are attached to the binding posts of the dynamo.

"The wires are insulated with cotton cloth and white lead, and when passing through damp places they are further protected by rubber tubing. On each main wire and near the dynamo, as well as near each group of lamps, is a cut-out plug which contains a short piece of fusible wire. The main office of this plug is twofold: it may be used as a switch to cut that wire out of the circuit at pleasure, also to prevent the heating of the wires beyond the fusing point of the metal (400 degrees), thus rendering the system harmless as to fire."

In this same report Chief Engineer Baird made very elaborate tests to determine the cost of operating, and gives a comparison of the cost of the electric light with gas on the basis of price charged by the Washington company. He figured out that the cost of the gas would be a little over three times what the Edison incandescent lamp was costing on that ship. He omitted the cost of labor, as no additional men were required for running the dynamo and engine. He figured out the electric light as costing $0.0135 per candle power per hour.

In the first installations simply a paraffin-covered copper wire was used for carrying the current; now there is first a layer of pure para rubber, then vulcanized rubber with a large quantity of the best grade of rubber in the compound, then braid, and either lead or steel tube for the outer covering. When the character of the work at that time is compared with that of the present day, one cannot help being impressed with the durability of electric plants. If, with such means as they had at their command in the early days, successful installation could be made, how much greater should be the results obtained at this time! Any well-designed installation today should last as long as the hull of the ship. The liability to damage from fire is a minimum. There is freedom from dirty, ill-smelling lamps which render ventilation difficult, and there is practically no heat. Electric fixtures are easily adapted to ornamental designs



MARINE GENERATING SET, CROSS COMPOUND ENGINE, GENERAL ELECTRIC TYPE.

and the lamps can be arranged to give the best lighting effect, and, for power purposes, a matter of no small account is the freedom from leaky steam pipes through cargo spaces.

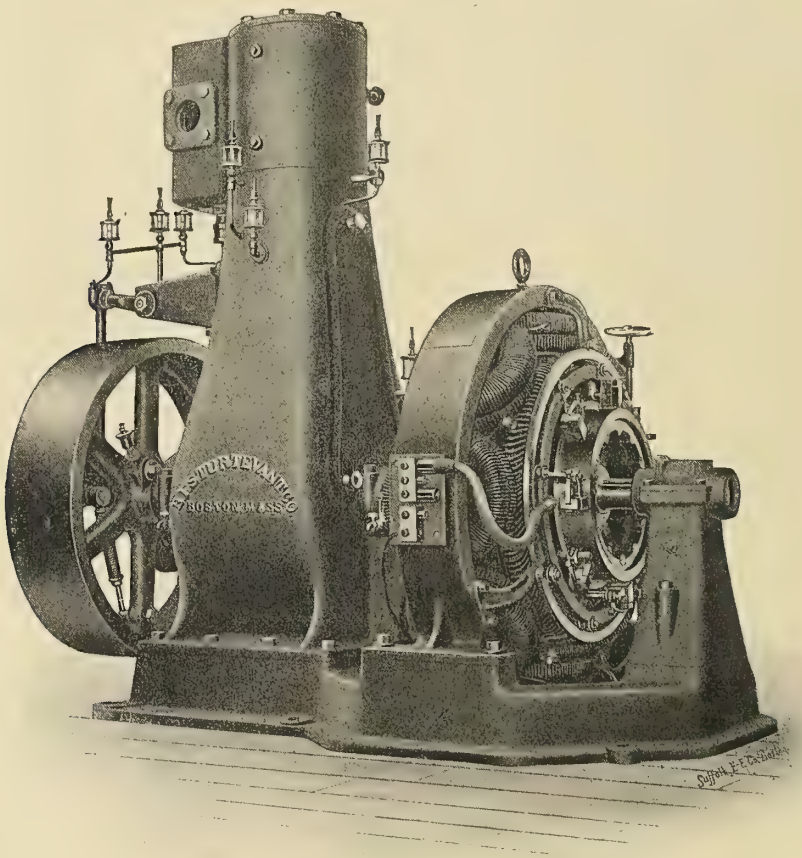
### GENERAL CONSIDERATIONS FOR MODERN PLANTS.

#### THE ENGINE.

In planning for the electric plant to be installed on board ship, consideration of the purposes for which the current is to be used must be given, whether to be used for lighting alone or also for driving auxiliaries. In this series of articles it is intended to treat of the uses for lighting and power, whereas the subject of indicators, telegraph, etc., is a specialty and need not be considered in connection with the other installation.

It may be stated generally that direct-connected generating sets should be installed for all classes of work; these consist of an engine and electric generator connected by shaft or coupling and mounted on a single cast-iron base. They vary in size from 2 to 100 kilowatts; the engines single or double tandem and compound, and generators compound wound from 60 to 125 volts.

In the original installations the machines were all belt-driven, as they were designed for very high speed, but later, when it was possible to design machines with lower speed, the United States Navy introduced direct-connected sets and used them exclusively. The change has gradually come about, and now it is the exception when a belt-driven set is installed on a steamship. The conditions in the engine room of the steamer, where the plants are usually installed, render the use of a belt very objectionable. The space required for the belted plant is greater than the direct-connected, which was also a large factor in bringing about the change, as, in designing machinery for use on shipboard, weight and space are questions of vital importance.




SINGLE-CYLINDER, DIRECT-CONNECTED STURTEVANT TYPE OF MARINE GENERATING SET.

The reciprocating engines as used at the present time for small plants are generally vertical, single-cylinder, double-acting. A few years ago it was believed that the double-cylinder engine was the only practical one for driving electric machines. These engines were designed with short stroke, very high speed, and were made very light. They were so wasteful in the use of steam and deteriorated so rapidly that longer strokes were used in later designs and the machines made heavier. Under these conditions it was possible to design a single-cylinder engine that gave very good economy, and, on account of the simplicity of construction, had good wearing qualities, was well balanced, and could be depended upon to operate under all conditions met with on shipboard. For the larger sets and for use with higher steam pressures the single-cylinder set is modified into a tandem compound, which has the same advantages of simplicity in the moving parts. As head room is often limited, the cross compound engine is used to a large extent, and there are many well-designed, substantial engines of this type in use at the present day.

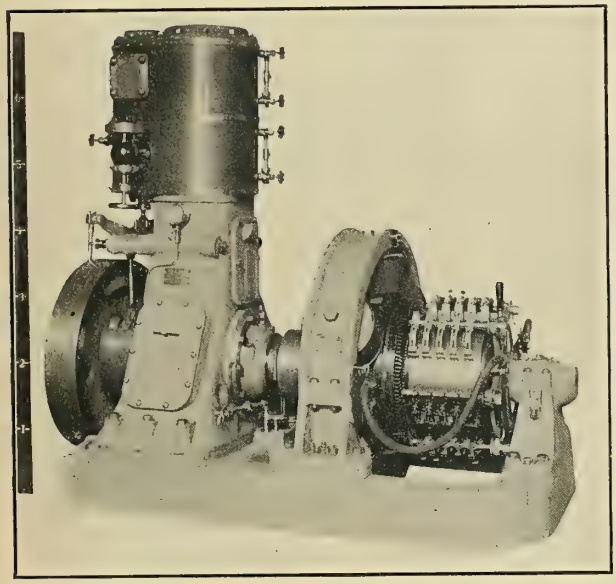
### SIZE AND NUMBER OF UNITS.

If, as is generally the case, the current generated is for lighting principally, where the plant has to run for several hours under practically constant load and the balance of the time at a gradually varying load, a compound engine can be installed for the purpose of economy; but generally it will be found, unless the plant is a very large one, of 500 or more lights, there will be very little gain in the use of compound engines. It is generally feasible to run the plant condensing at the time of heaviest load, and if the main condensers are not operating it is usually when the vessel is in port and the full complement of light is seldom used. At light loads the economy of the compound engine over the simple engine is not marked. If, in addition to the lighting load, there is a power load that is varying greatly, the compound engine would not be operating economically. Therefore, for all plants under 50

kilowatts, it should be satisfactory to install single-cylinder engines. It is preferable to install two or more generating sets where the load varies, either set to be a little larger than necessary to carry half of the load.

When the full load is on, two sets could be running without being overloaded, and in case of emergency one set could operate at an overload and take care of all the necessary lighting. For periods of light load, one set could be in operation under conditions of half-load, thus giving fair economy. For all plants with 200 lights or less, one direct-connected, single-cylinder set will be found to be generally satisfactory and reliable under all conditions of service.

In planning a large plant for the use of lighting and



STANDARD SINGLE-CYLINDER MARINE GENERATING SET. GENERAL ELECTRIC COMPANY.

power, sufficient capacity should be supplied for taking care of all of the lights and all of the ventilation, with the sets operating practically at normal load.

This will generally be sufficient to take care of the hoisting apparatus, which is in operation at times when the lighting and ventilation load is light. It is not desirable to install a plant that is much too large for the work to be done, for the conditions on shipboard hold much the same as on shore. In a central station plant for large power purposes the generating capacity is never sufficient to care for the total load in case all the motors are operating fully loaded at one time, as it is found unnecessary to install a plant for more than ½ to ¾ full-load requirements. The plant should be located conveniently with reference to the main steam supply, and where it will be well cared for and can be properly installed so as to be free from vibrations or noise that may be transmitted to various parts of the ship.

In locating the generating set on shipboard it should be placed with its shaft fore and aft. If placed athwartships the rolling of the ship may interfere with the lubrication of the bearings and cause trouble. The deck on which the set is placed should be stiff, and it is well to put stanchions between the decks beneath the bed plate. The cast-iron bed of the generating set should rest on a framework of wood, from 3 to 4 inches thick, which is well fitted to the deck. The generating set should be secured by foundation bolts which connect with the deck beams, if possible. The wooden base should be covered with a sheathing of lead slightly raised around the edges outside of the base, to act as a trough to collect oil and water which accumulate around any steam engine. In connecting up the engine, sharp bends in the steam and exhaust pipes should be avoided as much as possible. All pipes should be well covered with non-conducting material. A drain pipe with valves should be provided just above the throttle valve, in order to drain the pipe line of condensed water. A separator should be installed on the steam pipe close to the engine, to collect water which is occasionally carried over in the steam. The engines are generally fitted with a relief valve, but these are not intended to take care of any flood of water. Where the single-cylinder simple engines are used the most economical pressure at which to operate is from 80 to 100 pounds. As most vessels to-day are designed to carry a much higher pressure than this, it is necessary to install a reducing valve in the steam pipes leading to the generating set. This should be located in or near the dynamo room.

The high-pressure valve in most generating sets is of the balanced-piston type. The use of this type of valve secures a light mechanism with freedom from friction, which is easily controlled by the governor, thus insuring good regulation. There is a difference of opinion as to the type of valve best suited for the low-pressure cylinder on compound engines. Under most conditions of service it has been demonstrated that the piston will operate with much satisfaction. The balanced slide valve, if properly designed and accurately fitted, will probably give less trouble from leakage of steam. In case of any unusual pressure in the low-pressure cylinder it will lift from its seat and free the cylinder. Piston valves for both high- and low-pressure cylinders have given excellent results, however, and are recommended for all types of engines intended for electric service.

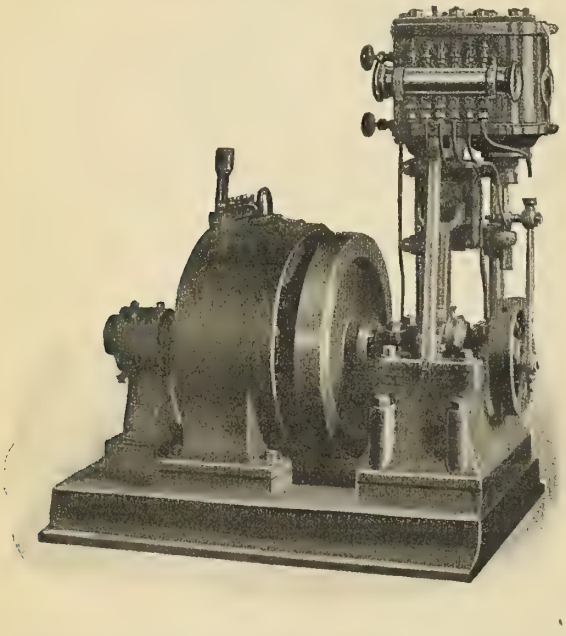
In the engines built in this country, shaft governors are used exclusively, and generally these are of the inertia type, controlling the valves by means of an eccentric pin on the flywheel, the centrifugal force of which is opposed by a spring. Any change of load will tend to change the speed, thus moving the weight, which draws the eccentric pin to or from the center of the shaft, changing the throw of the valve and varying the steam admission so as to maintain the engine at practically constant speed. Governors are usually designed to change the cut-off from ¾ to zero.

### LUBRICATION.

Generally the lubrication of the engine is obtained by a conveniently located oil tank with a number of adjustable sight-feed tubes. There has been a tendency recently to use what is known as the forced system of lubrication. In this there is a pump connected with a reservoir, which is operated by an eccentric on the engine shaft, forcing the oil to grooves in the main bearings, from there to the crank pin, thence to the wrist

pins and guides. It is then returned to the base, strained, and forced again through the bearings. A constant pressure of oil on all the main bearings of from five to twenty pounds is maintained. This system has been found to be perfectly reliable, preventing hot bearings and reducing wear to the minimum with the least attention.

Only mineral oil should be used, and better results are had with heavy oils. A mixture which has given good results is 2-3 heavy engine oil and 1-3 heavy cylinder oil. All lubricants will gradually become thick and gritty after having passed through the bearings repeatedly, so occasionally the oil should be drawn off, filtered, and mixed with new oil.



FORBES HIGH-SPEED, LIGHT-WEIGHT ENGINE AND DIRECT-CONNECTED GENERATOR.

As regards cylinder lubrication there is much difference of opinion; it is generally claimed that boilers are damaged by the introduction of oil, and it is the endeavor of all engineers now to operate without oil in the steam spaces. There is no doubt that a cylinder can be run without the use of a lubricant, if care at first is exercised in securing a perfect surface; but when the engine is shut down the cylinders will rust, and on starting up again there must of necessity be considerable wear and cutting due to grit which is cut off by the piston.

It is recommended that instead of doing away entirely with the cylinder lubricator, one should always be installed, and while the engine is in operation very little oil be used, but before shutting down the oil feed should be increased and the working surface well covered with a film of oil. One of the advantages of the steam turbine is the doing away with all lubrication in the steam spaces.

Piston rods should be of forged steel, also connecting rods and crank shaft; the main bearing boxes should be babbited cast-iron shells firmly secured in the bed of the engine; this construction facilitates adjustment and repairs.

GENERATORS.

The electric generators for use on shipboard have developed along the same lines as for those for use on shore. The universal practice to-day is to use armatures with the slots punched in the laminations, which are assembled on shafts forming the main body of the armature, the conductors embedded in these slots and ventilated by means of air ducts formed in the armature body by space blocks placed at intervals between the punchings. The armature coils are all form-wound, thus securing uniformity of construction, and when assembled on the bodies and connected to the commutators insure a good mechanical job.

The commutator, brushes, and brush holders should be kept perfectly clean and free from dust. The commutator should be wiped occasionally with a piece of canvas slightly coated with vaseline or oil, but lubricant of any kind on the commutator should be used sparingly.

*(To be continued.)*

## Special Session of the Board of Supervising Inspectors of Steam Vessels.

Under date of May 23, Leslie M. Shaw, Secretary Treasury Department, issued the following circular to those interested in the revision of the laws, rules, and regulations of the Steamboat Inspection Service:

"The Department, being in receipt of numerous letters from the large marine-boiler manufacturing companies throughout the United States, and many other marine associations, as well as individuals interested in the marine laws, and rules and regulations of the Steamboat Inspection Service, calling for a revision of many of the rules and regulations governing the construction of marine boilers, and relating to the inspection of vessels and licensing of officers, also the inadequacy of the present laws to meet the requirements of the growing marine interests of the country, has deemed it advisable to call an extra session of the Board of Supervising Inspectors of Steam Vessels, to meet in the city of Washington, D. C., on Wednesday, June 3, 1903, for the purpose of joint consultation relative to revising the said rules and regulations, and to consider and recommend to Congress at its next session such revision of the laws as may be necessary to meet and carry out in the most effective manner the intent and purpose of the provisions of Title LII relating to the Steamboat Inspection Service.

"With a view to obtaining all the information possible, and to meet the wants of all concerned, the Department extends to all interested an invitation to suggest to the Board of Supervising Inspectors at this extra session, either in person or by written communication, such changes as they may deem of a character worthy of consideration."

It will be remembered that during the close of the last session of Congress a bill was introduced for the appointment of a special commission to investigate what changes ought to be made in the present rules and to recommend same to the next Congress. The bill did not pass. The Secretary of the Treasury has decided that special legislation was not necessary and that such investigations may be carried on through the Supervising Inspectors. Change of rules is only possible by act of Congress, while the regulations may be revised by the action of the Board of Supervising Inspectors.

The Board, under the presidency of Mr. George Uhler, Supervising Inspector General, is hearing most interesting and voluminous communications from shipbuilders and boilermakers throughout the country, with the intention of thrashing out the rules for recommending almost an entirely new code to the next Congress.

SHAMROCK III.

### Voyage of the New Challenger.

Convoyed by the steam yacht *Erin* and the big Liverpool tug *Cruiser,* Sir Thomas Lipton's defeated challenger *Shamrock I.* and the untried challenger *Shamrock III.* arrived in the New York harbor on June 14, after a rough voyage of 16 days and 22 hours from Gourock, Scotland. This time included one day's stop at Fayal, in the Azores, to replenish the coal supply of the steam consorts. An average speed of about 240 miles a day was attained throughout the voyage of 3,644 miles. The yacht *Erin* is equipped with the wireless telegraph and dispatched several messages to the shore, reporting rough weather most of the voyage. On the second day out, and three days before arrival, easterly gales were encountered, which, however, did no damage to the little fleet. The *Shamrock III.* will be in charge of Capt. Bob Wringe in sailing the cup races. Mr. Fife, the designer, has sailed for this country in company with Sir Thomas, and, upon their arrival, the trial races between the three *Shamrocks*—for it will be remembered the *Shamrock II.* was left at Erie Basin—will be commenced.

The *Shamrocks,* in cruising rig, were manned by 42 men each, and the entire fleet of four vessels was 160. The *Erin* and *Shamrock I.* are already well known in these waters, and particular attention is attracted toward the new challenger, while her consort, the *Cruiser,* also was the subject of much interest, as she is a type of vessel unknown to these harbors. It would appear that the new challenger much resembles the *Columbia* above water. Herewith is presented a view of the *Shamrock III.,* taken before she left the other side, and in racing trim.

BIRD'S-EYE VIEW OF THE KRAJEWSKI-PESANT

## KRAJEWSKI-PESANT COMPANY.

After the war with Spain, in 1898, the Krajewski-Pesant Company, of New York, acquired a large tract of land on the water front of the harbor of Havana, Cuba, at Regla, where a machine shop and foundry had been established several years previously. Up to this time the company had not entered the marine field, but for many years had been a manufacturer of sugar machinery. At the new plant at Regla a boiler shop was built and equipped with modern tools, and the foundry and machine shops were enlarged and improved by the acquisition of new tools and machines.

The shipyard is known under the name of the Havana Iron Works, and has a frontage of 435 feet and a depth of water of 22 feet at low tide. There has recently been built a wooden pier 325 feet long and 30 feet wide, and it is the intention of the company to build two more piers.

In 1901 a large floating dry-dock was built by the company, which, as shown in the engraving, is placed close to the shops. The capacity of this dock is for vessels up to 6,000 tons. It is of the composite type—namely, made of steel frames, planked with heavy timber pine, covered with tar, felt, and copper sheathed. The total length at the keel track is 360 feet, the width between the side walls or wings is 70 feet, and the extreme width over all is 88 feet. The dock is equipped throughout with modern improved machinery and for working at night-time is lighted with electricity.

Besides this dock, the company has also in operation a marine railway of 400 tons capacity, for handling the smaller class of work. There are facilities for conducting all kinds of marine repairs at these works, and also for building steam launches, barges, marine boilers and engines. It is anticipated that the capacity of the yard will be increased by the building of new shops and erection of improved tools and machinery in the near future.

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**Canadian-Built Dredge.**—We are requested to state that the dredge *J. Israel Tarte,* described in the June number of MARINE ENGINEERING, was designed for the Department of Public Works, Canada, by Mr. A. W. Robinson, consulting engineer.

## FORTY-SEVENTH MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

From June 23 to 26 the forty-seventh meeting of the American Society of Mechanical Engineers was held at the United States Hotel, Saratoga, N. Y. An interesting number of technical papers were read, a synopsis of which will be found below. A local committee provided entertainment for the guests in the form of receptions and excursions to several large manufacturing companies in that district. Included in the latter were trips made to the works of the General Electric Company and the American Locomotive Works at Schenectady, and to several points of interest in the immediate neighborhood of Saratoga.

Abstracts of the papers read at this meeting are as follows:

### TESTS OF 12-HORSE-POWER GAS ENGINE TO DETERMINE THE EFFECTS OF CHANGES IN SPEED, LOAD, POINT OF IGNITION, RATIO OF GAS TO AIR, AND JACKET TEMPERATURE; BY PROF. C. H. ROBERTSON.

This paper gives the record of tests made at Purdue University and continuing over a period of six years. The equipment of the engine with indicator rig, Prony brake, gas meter, etc., is shown and described. The tests were 15 minutes in length in all cases, and the conditions under which each series was run are given. It is stated that not until the fourth year were most satisfactory results reached. The curves of results show—1. At a given notch of the mixer valve, speed, jacket temperature, and point of ignition, that the ratio of gas to air decreases as the horse power is increased. 2. The effect of a given change in the position of mixing valve, upon the ratio of gas to air, is very much more marked at the lower than at the higher notches. Also, that a change in the position of the mixing valve, or in the setting of the gas valve, is accompanied by a change in mechanical efficiency. The author's conclusions are stated under subheads, First, in regard to the effect of changes in point of ignition. (*a*) The highest mean effective pressure is secured between normal and late ignition, probably close to the former. (*b*) An increase of horse power calls for a later point of ignition if the highest and mean effective pressure is to be secured. (*c*) Early ignition causes an increase in frictional horse power.

Concerning changes in jacket temperature—(*a*) Increase in jacket temperature produces decrease in mean effective pressure, and the effect is more marked at low than at high powers. (*b*) Increased jacket temperature produces decrease in frictional horse power. (*c*) Increase in jacket temperature produces decrease in heat absorbed by jacket. Concerning the effect of change in speed—(*a*) Increase in speed produces increase in mean effective pressure. (*b*) Increase in speed produces increase of frictional horse power. (*c*) Increase in speed necessitates increased gas consumption per horse power.

COMPANY'S WORKS, AT REGLA, HAVANA, CUBA.

Concerning the effective changes in brake horse power—(*a*) Increase in horse power causes a decrease of mean effective pressure, the increased power being secured by an increase in the number of explosions. (*b*) Increase in horse power increases the frictional loss up to three H. P., above which a decrease is shown. It is suggested that this decrease at the higher powers is due to decrease in piston friction—due, first, to the increased time of contact with heating gases; second, to the decreased contact with cold air; third, to a higher temperature of the cylinder lubricant, thus minimizing the transfer of heat to the jacket water.

Conclusions in general. (*a*) The lowest gas consumption per indicated horse power and the highest thermal efficiency are secured under the following conditions: Ignition between normal and late jacket temperature, lowest used, or 90 degrees: speed, lowest tried, 150 R. P. M.; brake horse power about six-tenths of normal capacity of the engine. (*b*) From the practical standpoint of gas economy and thermal efficiency based upon brake horse power, the frictional horse power is an exceedingly important factor, being, in many cases, sufficient to more than counterbalance the decided thermal disadvantages. The lowest fractional horse power and the highest mechanical efficiency are secured with late ignition, high jacket temperature, low speed, and the highest horse power available.

BURSTING OF EMERY WHEELS; BY C. H. BENJAMIN.

This paper with illustrations and table gives the results of tests made on a number of emery wheels of various makes, bought in the open market. The wheels selected were all of one size and were tested to the bursting speed by the same method as used in "The Bursting of Small Cast-Iron Flywheels," as described in Vol. XXIII. of the Transactions. The illustrations show the character of fractures, and the table includes the working and bursting speeds and factors of safety.

UNITED STATES ARMY GUN FACTORY, WATERVLIET ARSENAL, NEW YORK; BY J. M. B. SCHEELE.

The object of this paper is to give a general description of the Watervliet Arsenal for the benefit of those members who avail themselves of the invitation to visit the arsenal. A brief account of the shops is given, and attention is called to the most interesting details.

THE HOT WELL AS AN OIL EXTRACTOR; BY A. H. ELDREDGE.

The author gives a brief description of the details and action of the hot well and its use for the separation of oil from the water from the cylinder which passes through it. (Illustrated.)

TESTS OF AN HYDRAULIC ELEVATOR SYSTEM; BY REGINALD PELHAM BOLTON.

The system detailed in this paper is that installed in a new department store in New York. A description of the various elements is given, and the general conditions which prevailed during the trial. Types of elevators, pumps, engines, and boilers, etc., are all given, and sample indicator cards are shown. The results of the observations are recorded in the customary manner.

FITS AND FITTING; BY STANLEY H. MOORE.

The author makes an investigation of recent practice in forcing, shrinking, driving, and running fits, and limits for limit gages. The crude or working material upon which the investigation is made was obtained from the published data in various technical papers, including the results of scientific investigation and successful practice. The method of obtaining the resultant formulæ is explained and the subject taken up under the various headings given above. For each case the data are transferred to rectangular co-ordinates where the curve is plotted for the purpose of obtaining a probable law. An empirical formula is next deduced and transferred to a so-called typical diagram. Representative curves are next selected which would clearly indicate good practice. A diagram showing the curves is given for each individual case, and also one of the representative curves for the various fits. The results are also included in a table at the end of the article, as a convenient form for reference.

POSITIVE GOVERNOR DRIVES FOR CORLISS ENGINES; BY A. H. ELDREDGE.

The author strongly advocates the use of gearing or sprocket and chain to replace belts for governor drive. He cites a case of three compound engines driving alternating-current generators. With belt drives it was impossible to keep oil from the belts, and great difficulty was experienced in throwing any two of the alternators in parallel, as the engine regulation was so poor. A positive bevel gear drive was then installed, since which time the alternators can be run in parallel with greatest ease. The sprocket-and-chain method is applied to a cross-compound Ball ice machine, and has given excellent satisfaction. Chain drive is cheaper than the geared drive, and is not affected by wear of the main bearings, requires less attention, and runs much more quietly. The appearance, however, is not so good. With the belt drive there is always the danger of slipping and a runaway engine where the so-called safety devices fail to work. (Illustrated.)

TURBINE FLOW RECORDER; BY C. M. ALLEN.

The author outlines the usual method of measuring the amount of water used when bought from an outside source of supply. He then explains the design and action of a device which automatically records the quantity of water discharged from a turbine with variable gate openings and under variable heads. The single- and double-cylinder types of recorder are then described, and the method of attachment. A further modification of the machine enables it to record the flow of water in mill-power hours. This paper was presented at the January meeting in New York city. (Illustrated.)

SHOP MANAGEMENT; BY FRED W. TAYLOR.

This paper is a very exhaustive treatise on some of the different systems of shop management, including methods of timing the rate of work, the amount of the day's work, and the methods of rewarding the laborers.

THE MECHANICS OF AIR-BRAKE SYSTEMS; BY H. G. MANNING.

As a preliminary, a short historical account is given of the

present air-brake system, and the three companies are mentioned whose systems are now in use. The general principles follow, and attention called to the fact that these systems differ only in small mechanical details. After mentioning the essential elements, the different types of air pumps are taken up, then follows a description of the engineers' valve, with the details in which the three types differ. The service and emergency application of the brake are discussed, and the paper closes with a description of the three types of triple valve.

THE STEAM TURBINE FROM AN OPERATING STANDPOINT; BY F. A. WALDRON.

This paper treats the subject not only from an operating standpoint, but includes as well data from the boiler room to the motor pulley. There is first given a general statement of facts which led to the choice of a Westinghouse-Parsons turbo-generator for installation in the Yale and Towne plant, continuous operation of the old plant during the installation of the new, floor space and economy being the three most important considerations. Details of the plant with methods of distribution are next given, and is followed by a brief description of the condenser plant. The motors, which are of Westinghouse and General Electric type, ranging in size from one-half to 40 H. P., and of the induction type, are discussed. Driving of tools is done by the group method, and a number of diagrams of various tests show the arrangement of shafting and pulleys. The steam end of the turbo-generating set has required practically no attention during the past year, and there has been no apparent wear of the parts. It has the advantage that it requires only a short time to warm up before starting, and the oiling, adjustment, and changing of speed are very simple. The blades have given no trouble, and the worst fault is the tendency to shut down at approximately full load, due to destruction of the vacuum. The only serious trouble was with the electrical end.

Answers are given to a number of questions, some of which are briefly as follows: It does fulfill the guaranteed economy. The noise is not excessive nor disagreeable. The continuity of operation is satisfactory. The exhaust can be used for heating purposes; it can be changed from condensing to non-condensing with ease, and this is done daily. The exciter should be driven by an independent engine. The cost of such a generating outfit is 10 to 15 per cent. less than an equivalent reciprocating engine. The vibration is not at all excessive. The paper closes with a number of boiler, economy, and motor tests.

AN INDICATING ANGLE METER; BY C. E. SARGENT.

The device described was designed to determine at sight the actual maximum variation in engine flywheels, particularly of the internal-combustion type, and its chief use is in running alternators in parallel. It is universal in its application, portable, easily attached, substantially built, and direct reading, the angular variation per revolution being shown by the position of a needle on a dial. A detailed description is given, and its method of attachment explained. (Illustrated.)

PERFORMANCE OF AN INTERNAL-COMBUSTION ENGINE USING KEROSENE AND GASOLINE AS FUEL; BY H. F. HALLADAY AND G. O. HODGE.

This paper is the outgrowth of a series of tests made to determine the economic performance of a standard internal-combustion engine of the Otto type, using kerosene and gasoline under similar conditions. The engine used was a standard horizontal four-cycle type, made by the Otto Gas Engine Company. The subject is treated under the following headings: The cooling jacket; the absorption brake; the carburetter for kerosene; the weighing tanks for fuel; kerosene used as a power gas; adjustments and methods of testing with kerosene fuel; the conditions of conducting experiments; the heating value of the fuel; the chemical analysis of fuels; fuel consumption; mechanical friction and efficiency; heat distribution; thermal efficiency and duty; conclusions, together with various tables.

ALTERNATING-CURRENT MOTORS FOR VARIABLE SPEED; BY W. I. SLICHTER.

The author does not claim that this type of motor can compete with the direct-current type where a continual variation of speed is desired, but shows that where an alternating-current system is desirable variable speed can be obtained with good results. He then discusses the characteristics of the polyphase-induction motor and the various methods of speed control, together with their advantages and efficiency.

A METHOD OF TESTING GAS ENGINES; BY E. C. OLIVER.

The object of this paper is to describe methods and apparatus in use in some tests on a 10-H. P. Otto gas engine, to determine the distribution of the heat supply by the fuel, and the temperature at various points in the cycle, and to submit the results of the heat tests. The data on which the results were based were as follows: Indicated horse power; brake horse power; weight of air; weight of fuel; heat rejected to exhaust; heat absorbed by jacket; total revolutions; total explosions; analysis of fuel; analysis of burned gas; engine constants; and duration of test. (Illustrated.)

TEST OF A DIRECT-CONNECTED 8-FOOT FAN AND ENGINE; BY E. S. FARWELL.

The object of the test described was to obtain reliable data which would serve as a guide in the selection of size of apparatus for a given case of heating. The question embodied three distinct problems—the air pipe; the fan; and the heater; the starting point is the volume and temperature of air required. The methods of conducting the test are outlined and the different details discussed. The results are embodied in a table, and various efficiency curves are shown.

A RATIONAL TRAIN-RESISTANCE FORMULA; BY JOHN BALCH BLOOD.

A brief history of train-resistance formulæ and their development is given, with discussion of each. The desirability of a rational rather than an empirical formula is outlined and a development of a formula advocated by the author is given, together with the causes necessitating additional terms, as, for example, increased train speed, and the necessity of having a formula which shall be accurate and not merely serviceable as a guide.

DRAWING-OFFICE EQUIPMENT; BY JOHN M'GEORGE.

The paper starts with a general discussion of drafting-room conditions; the question of light—both natural and artificial—is next considered; for the latter reflected light from the ceiling is given the preference, the ceilings being painted white, and the lamps being of the arc or Nernst type. The method of individual incandescent lamps is also mentioned. The question of the space allotted to each man is next discussed; three conditions controlling it being given, as—the convenience of the man, the necessary room to allow easy access to the supervisor, and ventilation. Various types of drafting boards with their relative advantages are allotted considerable space. Sanitary arrangements and electric blue-print facilities are mentioned. The Universal Drafting Machine and the Rapid-Sketching Device are described. Paper closes with remarks on drafting-office management. Paper includes a number of illustrations of drafting-room arrangement.

STRAINS PRODUCED BY EXCESSIVE TIGHTENING OF NUTS; BY A. BEMENT.

A brief paper calling attention to the fact that materials are frequently unduly strained during the process of assembling, by the excessive tightening of nuts. An example is given.

SOME DATA ON HOISTING HOOKS; BY JOHN L. BACON.

The author gives the results of some tests made on the strength of hooks bent out of round stock, and compares them with tests on those shaped according to Towne's Formula, and, further, gives the effect of case-hardening. The method of conducting tests is described, and the conclusions are outlined in a table. (Illustrated.)

WATER AND HEAT CONSUMPTION OF A COMPOUND ENGINE AT VARIOUS POWERS; BY D. S. JACOBUS.

The engine tested was of the Rice and Sargent horizontal cross-compound type, provided with a Corliss valve gear. It is located at the Brooklyn plant of the American Sugar Refining Company. The method of testing and the conditions are described, and the results are given in various tables and figures.

A COMPARATIVE OIL TEST; BY WILLIAM F. PARRISH, JR.

The test described was made for the purpose of showing the relative efficiency of two different grades of oil, both of which were made for the same kind of service, *i.e.*, spindle lubrication. These tests were made on a cotton-spinning frame of the ring type at the Union Cotton Manufacturing Company's mill, Fall River, Mass. Various dimensions of the spinning frame are

given, and the various conditions of running the tests. The instruments used are enumerated and described. The conclusions are given in tables and diagrams.

EXPERIMENT BOILER OF OHIO STATE UNIVERSITY; BY E. A. HITCHCOCK.

This paper outlines the details and installation of an experimental boiler with its accessories in the power house of the Ohio State University, and gives the results of various trial running.

A GRAPHICAL DAILY BALANCE IN MANUFACTURE; BY H. L. GANTT.

This paper may be said to be a continuation of the paper presented by the author at the last annual meeting, and calls particular attention to the method of setting the task and the method of operating the system by which an exact record was kept. The first of these two items is treated quite fully by Mr. Fred W. Taylor in his paper before the present meeting; the second item is the one which is given careful consideration in this paper. It is treated under the following headings: Man's record; daily balance of work; a foundry balance; a daily balance as a permanent record; a machine-shop balance and routing sheet; a graphical balance as a history; a value of balance not dependent upon method of compensation; the graphical balance and the foreman; cost of keeping balances; time- and production-card system; cost; progress of production; difficulty of getting a daily balance; value of such a balance. Sample forms are shown to illustrate certain points in the system.

TOPICAL DISCUSSIONS.

This includes short description of a milling-machine attachment for cutting worms. Another topic suggests the adoption of a standard form of boiler for testing the calorific value of various fuels. The third item describes a new form of flexible metallic tubing.

A 60-FOOT BORING MILL; BY JNO. A. RIDDELL.

This describes the new boring mill at the works of the General Electric Company.

## Drawings of Modern Triple-Expansion Engines.

A thorough understanding of the triple-expansion engine and the correct names of the different parts is only clear after many months of study and experience in the drafting room and in the engine room. On the inset is presented a set of working drawings of a modern triple-expansion engine recently built, which embodies the latest designs and may be looked upon as the standard practice of to-day.

This engine is what is generally termed a vertical inverted cylinder, direct-connected, triple-expansion type, having one high-pressure cylinder 17 inches in diameter, one intermediate-pressure cylinder 27 inches in diameter, and one low-pressure cylinder 43 inches in diameter, the stroke of all pistons being 24 inches. The high-pressure cylinder, **22**, is forward, intermediate cylinder, **23**, in the middle, and low-pressure cylinder, **25**, at the after end. The valve, **34**, on the high-pressure is of the piston type, and those on the intermediate, **40**, and low-pressure, **41**, are of the slide-valve type balanced by pistons, **1**. All valves are worked by the Stephenson link motion with double bar links, **28**. Each main piston has a piston rod, **33**, and a crosshead, **12**, working in a slipper guide, **13**. At either end of the connecting rod, **5**, brasses are fitted, the upper one to the crosshead pin, **14**, and the lower one to the crank pin, **7**.

The crank shaft, **9**, in this engine is made up in two lengths, of open-hearth steel; the abutting ends have collars forged on them which are coupled together by bolts. The framing of the engine consists of three

FLOATING DRY-DOCK AT THE WORKS OF THE KRAJEWSKI-PESANT COMPANY, REGLA, HAVANA, CUBA.

wrought-iron front columns, **16**, and three cast-iron columns at the back, **15**, cast in the main condenser, **3**, the condenser forming part of the framing. The engine bed plate, **2**, is also cast-iron and is laid upon a wrought-steel foundation forming part of the structure of the ship.

First let us consider the progress of steam through the cylinders. Steam enters the high-pressure valve chest through the connection marked **27**a, around the piston valve, **34**, and is admitted into the high-pressure steam cylinder, **22**, through the steam passages. As shown in the drawing, the high-pressure cylinder is on the top center; the valve is already opened to the amount of the lead to allow steam to enter behind the piston, **29**. Looking at the bottom of this piston valve, it will be seen that the lower steam passage is connected to the space below the piston valve, that is, the exhaust port is opened and steam is escaping from behind the piston to the intermediate-pressure valve chest, **47**, through the passage which surrounds the high-pressure cylinder.

Steam from the intermediate-pressure cylinder, **23**, is controlled in like manner by the slide valve, **40**; after doing its work in this cylinder it exhausts through the receiver pipe, **26**, in which an expansion joint is fitted on the line opposite the intermediate cylinder, to the low-pressure valve chest, **48**.

By means of the slide valve, **41**, it enters, performs its work, and exhausts from the low-pressure cylinder, **25**, passing into the main exhaust pipe, **27**, to the condenser, **3**, which is built in the back columns of the engine. This condenser is fitted with two nests of tubes, **4**, and through these tubes water is circulated by a centrifugal pump. The water at the bottom of the water chest, **43**, through the opening, **45**, passes forward through the lower nest of tubes, up at the forward end of the condenser, then backward through the upper nest of tubes and outward through the connection, **44**. The exhaust steam fills the spaces around these tubes, and in coming in contact with the cold surface of the tubes is condensed, falls to the bottom, and is removed by the air pump attached to the flanges at opening, **42**. This condensation creates a vacuum.

To accomplish these various operations and do it economically, each part of the engine must be studied in detail to produce the best results with the least amount of material and by using the minimum amount of steam. The reason of separate cylinders as in the multiple-expansion engine is twofold: first, the present large demands for power—one cylinder could not well be built in which to double the total amount of power, and even if so built it would not give a uniform turning moment to the shaft; and, secondly, by subdividing the expansion in two or more cylinders less condensation of steam results. This condensation is caused through the sudden heating and cooling of the cylinder walls with each revolution of the engine, due to the high temperature of entering steam and low temperature of the exhaust steam.

A REMARKABLE COLLISION BETWEEN A PILOT BOAT AND A HOUSE ON THE MASSACHUSETTS SHORE.

### A Wrecked Pilotboat.

It is seldom that a vessel so far leaves her element as to come in collision with houses on the shore, but the above engraving, taken from a photograph made by Dr. F. N. Damon, Scituate, Mass., shows again that the unexpected is always liable to happen. The vessel, which is seen lying under the weather side of a house, was the pilotboat *Columbia,* blown ashore some time ago during a very heavy gale and high water. She was forced into the house, and her masts and spars falling increased the wreckage of both the ship and the home.

The view also illustrates the greater strength of the design of the naval architect than that of his land brother. The hull of the vessel was not badly damaged, but the lower portions of the house were completely wrecked and piled up, as shown.

## ON THE LINES OF FAST CRUISERS.*

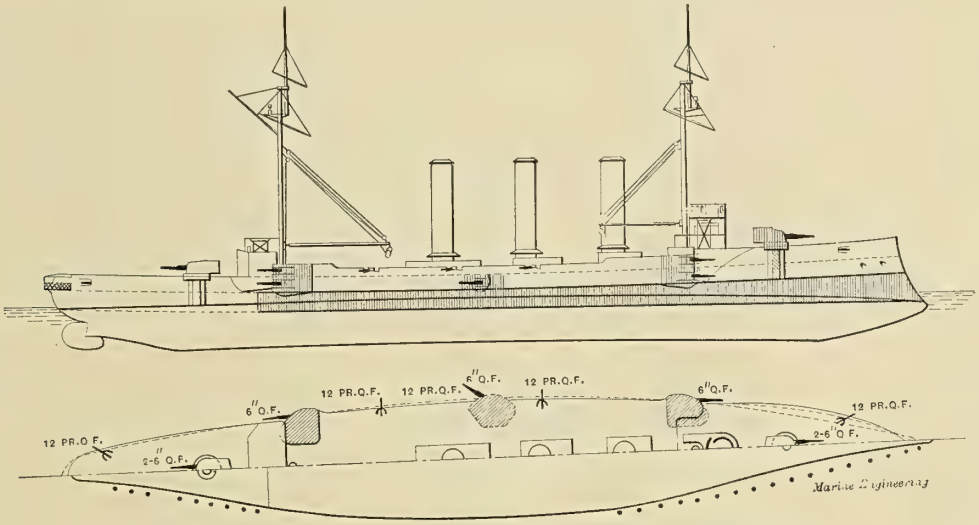
BY VICE-ADMIRAL C. C. P. FITZGERALD.

In bringing this subject before the notice of this Institution, I may say at once that I do so more as an inquirer than with the idea of laying down the law dogmatically as to what are or are not the best possible lines upon which ocean cruisers of high speed ought to be built; and, whilst venturing to offer some opinions on the subject from a seaman's point of view, I shall hope to evoke the opinions of some experienced naval architects upon the theoretical aspect of this interesting and important question, with the further hope that theory and practice may be found to go—as they ought to go—hand in hand.

Both professional naval architects and professional seamen know perfectly well that it is impossible to get high speed in any vessel without fine lines, and it is equally impossible to get very high speed without very fine lines. This sounds almost like a truism to those who know anything about the subject. No amount of horse power will avail unless the coefficient of fineness bears a certain relation to the speed required. But it appears to me that there is a great deal of difference between fine lines and hollow lines; and this brings me directly to the point which I trust some naval architects here present will elucidate for us, viz., whether there are any special advantages in hollow lines which are not apparent to the eye of a seaman, or which can be taken as an adequate compensation for the disadvantages which he knows them to possess in all conditions of wind and weather, with the sole exception of dead smooth water—a condition which, I need scarcely say, is very rare at sea.

I may perhaps point out here what I mean by reference to the Diagram on Plate I. This diagram shows the water line of our armored cruisers of the *County* class, and I think it can be scarcely open to question that their lines are very hollow, particularly the bow lines. I may observe that the ships themselves look even more hollow than the diagram shows, though this, of course, may be an optical delusion.

I have ventured to add to the original diagram a dotted line showing an imaginary water line which is not hollow, but slightly convex, and approaching more nearly to the lines of our 30-knot destroyers and of fast Atlantic liners, and I would ask the question whether these lines would require a greater horse power to drive them at a given speed than the hollow lines, even in smooth water. And, if this question is answered in the affirmative, I would still point out that by filling in this hollow, the ship would be given a greater displacement, and would in consequence be able to carry a greater weight of engines, and she would certainly be a better ship in rough water, even if there was a slight falling off in her trial-trip speed.




PLAN AND WATER LINE OF THE ARMORED CRUISER COUNTY AND CLASS.

I am quite aware that, generally speaking, comparisons between the designs of war cruisers and Atlantic liners are apt to be misleading, as the ships are intended to perform totally different services, and it is impossible to combine the requirements of both in any one ship. It is not necessary to enter into the details of this incompatibility, as they must be obvious to both naval architects and seamen; but there is one quality which is essential to both, and that is, length. You cannot drive a short ship against a head sea: it is simply impossible. Length is necessary in order to get anything like high speed in rough water; and, moreover, total length, or length over all, is of no use unless it is combined with length of floor; it is, in fact, actually detrimental, as it only increases the pitching moment. A comparatively broad and flat floor amidships, with two very fine and hollow ends, will only make a rocking machine, which may possibly be driven fast in smooth water, and may be suitable for a river steamer, but which is quite unsuitable for an ocean cruiser. I put forward these views on the subject as the crude remarks of a seaman, subject to the contradictions of applied science; but they are the result of many years' observation of the behavior of ships and

*Read at the Spring Meeting of the Forty-fourth Session of the Institution of Naval Architects, April 1, 1903.

vessels of various classes, in all conditions of wind and weather, and they must be taken for whatever they are considered worth.

In comparing the lines of our larger ocean war cruisers with those of destroyers, it is obvious that in the latter the proportion of length to breadth is greater than in the former, thus admitting of finer lines, and this length is no doubt necessary in order to get space for boilers enough to produce the great horse power required to drive these little vessels at 30 knots; but in examining the drawings of destroyers, and in looking at the vessels themselves, I am unable to see any hollowness in their lines. The lines appear to be almost quite straight, and in some boats slightly convex, until you get aft as far as the boiler space; and yet these little vessels (putting on one side some signs of structural weakness) have proved themselves to be splendid sea boats for their size, weathering Atlantic gales and typhoons in the China seas.

### TANK EXPERIMENTS.

I desire to speak with the greatest respect of tank experiments. I have not the smallest doubt that they have been of great use to naval architects in elucidating problems in hydrodynamics, and in assisting them to come to conclusions as to the form of model which offers the least resistance at various speeds. Such experiments and researches must always be useful in checking theory with practice, so far as such trials can be considered practical; though it must be borne in mind that all tank experiments relate only to smooth-water conditions, and it is quite possible that the conclusions arrived at through a combination of abstract theory and tank experiments with small models may be misleading, if applied too rigidly to full-sized ships which have to travel upon the troubled surface of the ocean. Indeed, it is impossible to help surmising that tank experiments are responsible for the hollow lines of which I am now speaking. If I am wrong in this surmise, I shall, no doubt, be corrected.

Some years ago we used to hear a good deal about the "wave line" theory; in other words, a hollow bow. Speaking from memory, I think it was introduced—or, at any rate, advocated—by the late Mr. Scott Russell: but I have certainly been of opinion that this theory has since been discredited, both by naval architects and seamen, for all ocean-going steamers, although it is possible that it may still be applied with success to river steamers; at any rate, it is certain that you will not see a hollow line in any of our fast Atlantic liners. Splendid models of these ships are on view in many public places, particularly in Cockspur street, so that any one can see for himself that there is no hollow in the bow lines; but that, on the contrary, the floor of the ship is carried right forward to the cutwater, a form which enables the vessel to rise to a sea instead of pitching deeply into it.

### A COMPARISON.

It has often been urged that comparisons between British and foreign cruisers are apt to be misleading, and unfair to the former unless the full particulars are known and set forth. This, no doubt, is perfectly true; but yet, in spite of the very high authority by which this warning has been issued, I think it will not be irrelevant to the present subject to compare the British *Kent* of the *County* class with the Russian cruiser *Bayan*, built at La Seyne. The *Kent* has a nominal tonnage of 9,800, the *Bayan* 7,800, and there can be no doubt that the additional 2,000 tons ought to give a great superiority to the *Kent* either in speed, armor, armament, or coal endurance. With regard to armor, there does not appear much to choose between them, although the distribution of it is quite different; thus the *Kent* has a belt 4 inches thick amidships, tapering to 2 inches forward, carried right to the stem; and the *Bayan* has a belt 8 inches thick amidships (but very narrow and short at this thickness), tapering to 3 inches forward, and carried right to the stem. In both cases the belt stops about 100 feet from the stern. The *Kent* has a 5-inch bulkhead; but I cannot find out whether the *Bayan* has or has not a bulkhead. The width of the thin belt in both ships is about the same.

The *Bayan* is armed with two 8-inch guns, protected with 7-inch armor; eight 6-inch, protected with 3-inch armor; twenty 2.9-inch, eight of which are behind 3-inch armor; and seven 1.8-inch guns. The *Kent* carries fourteen 6-inch guns, protected by 5-inch and 4-inch armor, and thirteen 12-pounders unprotected; her armored deck is 2 3-4 inches thick, against the *Bayan's* 2 inches, and the *Kent* carries more ammunition than the *Bayan;* but the latter has two submerged torpedo tubes, and the *Kent* has none. With regard to coal supply, the *Kent* carries 800 normal and 1,600 full stowage for 22,000-H.P. engines, and the *Bayan* carries 750 normal and 1,100 full stowage for 16,500-H.P. engines.

The *Bayan* was designed for 21 knots, and made 22 on her trial. The *Kent* was designed for 23 knots, and made 21.7 on her first trial; and, although she has somewhat improved upon that, owing to some alteration in her screws, she has not yet attained her designed speed, nor have any of her sisters. Presumably the *Bayan's* trial lasted for only three hours, and the Kent's for eight. The *Bayan* is 445 feet long by 57 feet beam, and the *Kent* is 440 feet long by 66 feet beam. The 5 feet additional length, coupled with 9 feet less beam, commends itself to the mind of a seaman as being a better form than the other one for driving against a head sea; and it seems to be no worse for attaining a good trial-trip speed. I have not been able to get the lines of the *Bayan*—it is difficult to get the lines of foreign ships; but I have seen a good many French-built ships, and I can safely say that I have never been able to detect a hollow line in any of them.

In the above comparison I have endeavored to be perfectly fair, and have impartially given such information as I have been able to collect; and it certainly does not appear as if our *County* class of 9,800 tons possess such a superiority over the *Bayan* of 7,800 tons as they ought to possess. It would be interesting to know if this is in any way attributable to their hollow lines.

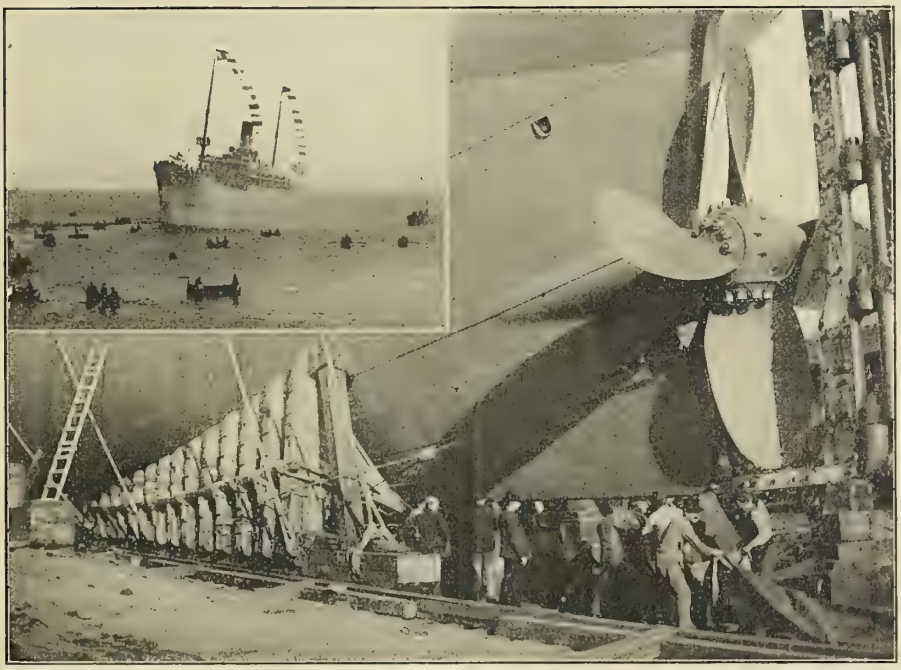
### CONCLUSION.

It is always rash to prophesy, and yet I will venture to predict that the whole of our *County* class will prove to be very wet ships. They will be wet for two reasons: one is that their sponsons are too low, and the other is that they have hollow lines, particularly the bow lines; and this, in combination with the armor carried right forward to the stem, will make them pitch with all the venom of much shorter ships; and it must be remembered that a wet ship interferes considerably with the accuracy of gunfire.

### New Steamships Umbria and Liguria.

The last of the five steamers of the Navigazione Generale Italiana Company placed in the American service is named the *Umbria*. She is of the intermediate type, with large passenger accommodations and moderate speed. The other vessels recently built for this company are the *Liguria* and *Lombardia* and the *Sicilia* and *Sardegna*. The former two ships were built by Messrs. Ansaldo, and the latter two at Riva Trigoso, Genoa. All five ships have been constructed to conform to the requirements of Lloyd's and to the Italian government. The hulls are of open-hearth mild steel.

STEAMSHIP UMBRIA AT GENOA, ITALY.



LAUNCHING THE STEAMSHIP LIGURIA AT GENOA, MARCH 31.

The principal dimensions are: Length, 402 feet; beam, 46 feet 7 inches; depth to the main deck, outside, 30 feet 4 inches.

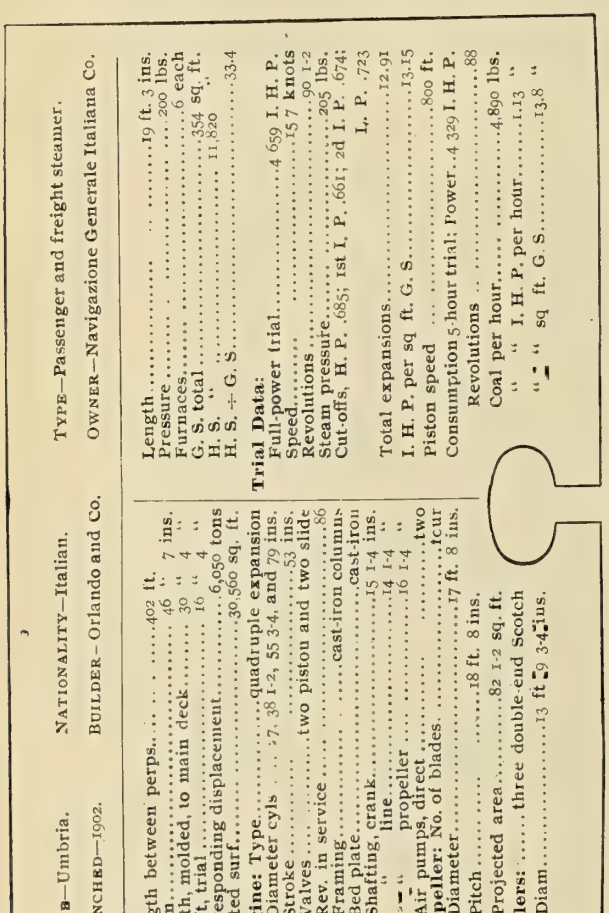
The ships have accommodations for 50 first-class, 50

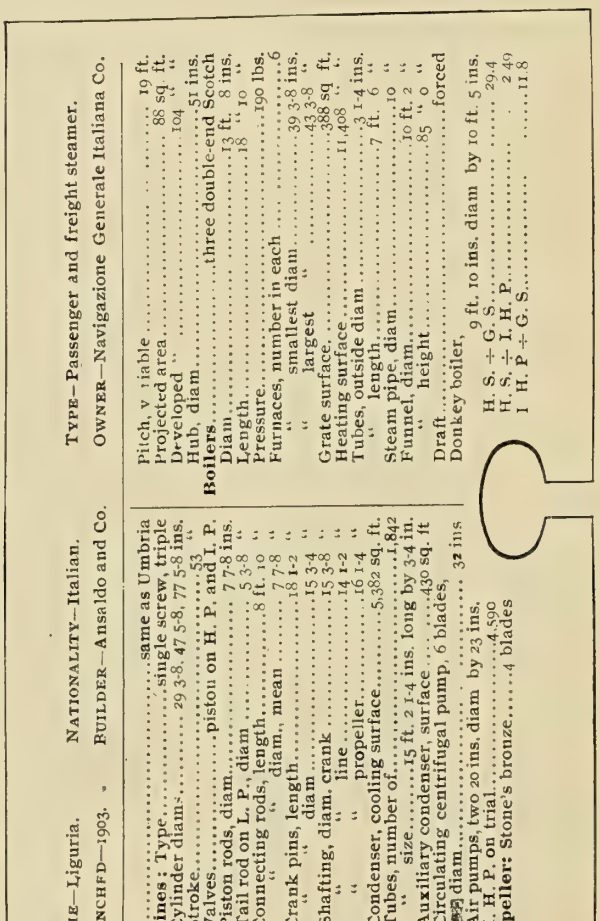
second-class, and 1,020 third-class passengers. Both classes are handsomely fitted and provision is made for carrying stores in large refrigerating chambers.

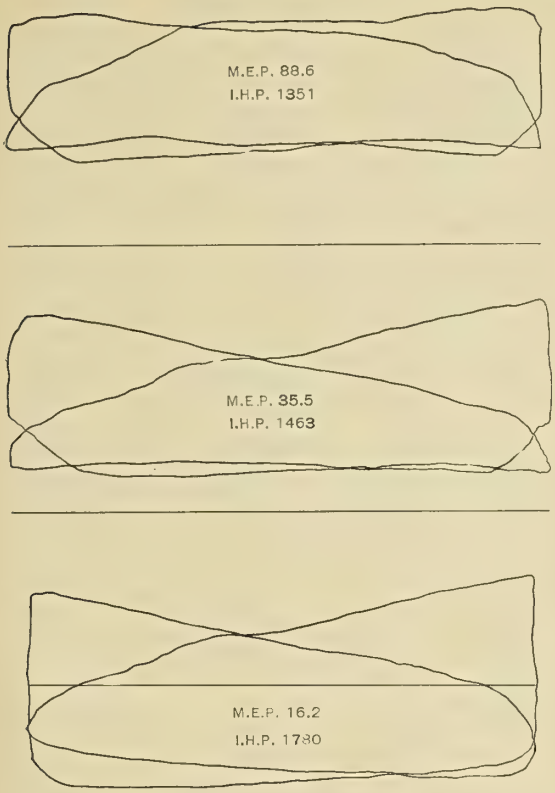
The propelling engine of the *Umbria* is of the four-cylinder, quadruple-expansion type, the order of the cylinders being, from the forward end: High, first intermediate, second intermediate, and low-pressure; while the crank sequence is high, low, first intermediate, and second intermediate, the cranks being placed 90 degrees apart. Piston valves are fitted to the high- and first intermediate-pressure cylinders, and slide valves to the other two cylinders. All are worked by Stephenson double-bar links. The valve chests of the two intermediate cylinders are placed on the backs of the cylinders, thus securing a short engine. Each cylinder and its chest is cast separately and tied together by forged steel rods at the tops and by cast-iron arms between the columns, which latter are of cast iron. The pistons are of cast steel and of weight best adapted for balancing the four cranks, the high-pressure and intermediate-pressure pistons being of the same weight and the second intermediate equal to that of the low-pressure piston. There is a separate cylindrical condenser with a steel plate shell and composition ends. The top of the condenser is arranged as a feed-water heater.

Steam is supplied by three cylindrical double-end boilers, working at 200 pounds pressure, placed in a single compartment. The auxiliary machinery, which is very complete, is in duplicate throughout to avoid the chances of a complete breakdown. On a trial trip the main engine developed a maximum power of 4,800 I. H. P., and the coal consumption during a five-hour trial was 11,097 Kg., which, figured out per horse power, was 1.13 pounds per horse power per hour; the trial was run at natural draft and the average speed throughout was about 15.5 knots. The trial was most satisfactory in all ways, and it should be remarked that these are the largest engines yet built of this type in Italy. The plans were drawn by Salvator Orlando, consulting engineer of the steamship company, and both hull and engines were built at the works of Messrs. Orlando at Livorno.

The engines of the *Liguria* and *Lombardia* are triple-expansion type, with cylinders 29 3-8, 47 5-8, and 77 5-8 inches diameter with a common stroke of 53 inches. Piston valves are fitted to the high- and intermediate-pressure cylinders, and the double-ported slide to the low-pressure, all worked by Stephenson gear; the high and intermediate have steam jackets. The cylinders are mounted on cast-iron front and back columns,


Name—Umbria.
Nationality—Italian.
Type—Passenger and freight steamer.
Launched—1902.
Builder—Orlando and Co.
Owner—Navigazione Generale Italiana Co.
Length between perps. 402 ft.
Beam 46 " 7 ins.
Depth, molded, to main deck 30 " 4 "
Draft, trial 16 " 4 "
Corresponding displacement 6,050 tons
Wetted surf. 30,560 sq. ft.
Engine: Type quadruple expansion
Diameter cyls 27.38 1-2, 55 3-4, and 79 ins.
Stroke 53 ins.
Valves two piston and two slide
Rev. in service 86
Framing cast-iron columns
Bed plate cast-iron
Shafting, crank 15 1-4 ins.
" line 14 1-4 "
" propeller 16 1-4 "
Air pumps, direct two
Propeller: No. of blades 4 cur
Diameter 17 ft. 8 ins.
Pitch 18 ft. 8 ins.
Projected area 82 1-2 sq. ft.
Boilers: three double-end Scotch
Diam. 13 ft 9 3-4 ins.
Length 19 ft. 3 ins.
Pressure 200 lbs.
Furnaces, 6 each
G. S. total 354 sq. ft.
H. S. " 11,820
H. S. ÷ G. S. 33.4
Trial Data:
Full-power trial 4 659 I. H. P.
Speed 15 7 knots
Revolutions 90 1-2
Steam pressure 205 lbs.
Cut-offs, H. P. .685; 1st I. P. .661; 2d I. P. .674; L. P. .723
Total expansions 12.91
I. H. P. per sq ft. G. S. 13.15
Piston speed 800 ft.
Consumption 5 hour trial: Power 4 329 I. H. P.
Revolutions 88
Coal per hour 4,890 lbs.
" " I. H. P. per hour 1.13 "
" " sq ft. G. S. 13.8 "

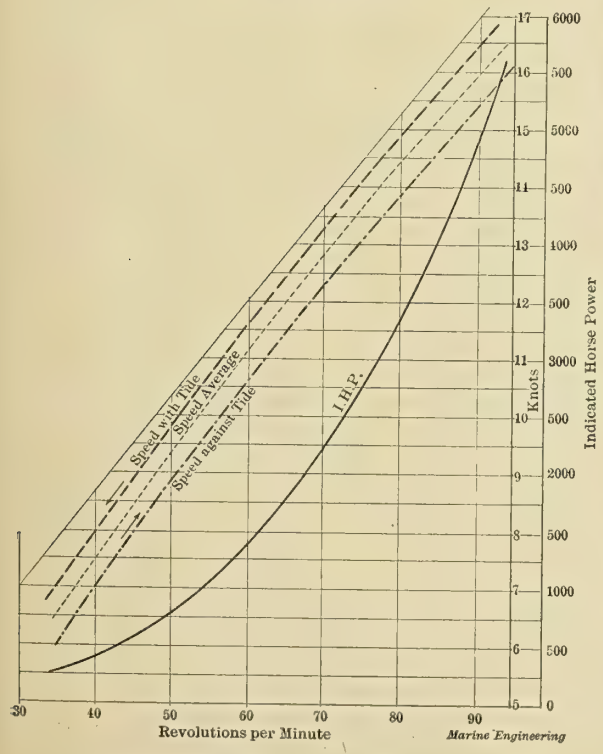

Name—Liguria.
Nationality—Italian.
Type—Passenger and freight steamer.
Launched—1903.
Builder—Ansaldo and Co.
Owner—Navigazione Generale Italiana Co.
Hull same as Umbria
Engines: Type single screw, triple
Cylinder diams 29 3-8, 47 5-8, 77 5-8 ins.
Stroke 53 "
Valves piston on H. P. and I. P.
Piston rods, diam 7 7-8 ins.
Tail rod on L. P., diam 5 3-8 "
Connecting rods, length 8 ft. 10 "
" diam., mean 7 7-8 "
Crank pins, length 18 1-2 "
" diam 15 3-4 "
Shafting, diam. crank 15 3-8 "
" line 14 1-2 "
" propeller 16 1-4 "
Condenser, cooling surface 5,382 sq. ft.
Tubes, number of 1,842
" size 15 ft. 2 1-4 ins. long by 3-4 in.
Auxiliary condenser, surface 430 sq. ft
Circulating centrifugal pump, 6 blades, 32 ins diam
Air pumps, two 20 ins. diam by 23 ins.
I. H. P. on trial 4,590
Propeller: Stone's bronze 4 blades
Pitch, variable 19 ft.
Projected area 86 sq. ft.
Developed " 104 " "
Hub, diam 51 ins.
Boilers three double-end Scotch
Diam. 13 ft. 8 ins.
Length 18 " 10 "
Pressure 190 lbs.
Furnaces, number in each 6
" smallest diam. 39 3-8 ins.
" largest 43 3-8 "
Grate surface 388 sq. ft.
Heating surface 11,408 " "
Tubes, outside diam 3 1-4 ins.
" length 7 ft. 6 "
Steam pipe, diam 10 "
Funnel, diam. 10 ft. 2 "
" height 85 " 0 "
Draft forced
Donkey boiler, 9 ft. 10 ins. diam by 10 ft. 5 ins.
H. S. ÷ G. S. 29.4
H. S. ÷ I. H. P. 2.40
I. H. P ÷ G. S. 11.8




| | |
|---|---|
| BOILERS PRESSURE | 191 LBS. |
| RECEIVER H.P. | 186 " |
| " M.P. | 72.5 " |
| " L.P. | 12.1 " |
| VACUUM | 26 INCHES |
| REVOLUTIONS | 86 " |

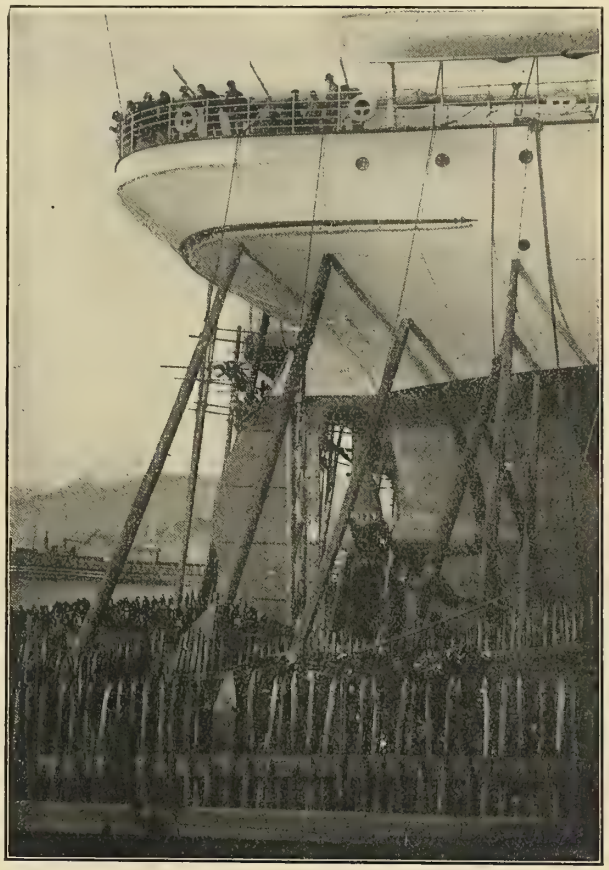
*Marine Engineering*

CARDS TAKEN ON THE LIGURIA.




SPEED CURVE FOR THE TRIAL OF THE LIGURIA.

those on the front being used for oil tanks; the crank shafts are Siemens-Martin, which is the material used for other moving parts, except for the propeller shaft, which is made of forged iron. Slipper guides are placed on the back columns with water circulation. The condenser is in the back framing of the engine, and two air pumps work direct from the intermediate- and low-pressure crosshead. A large evaporator is fitted for the make-up feed, and Weir feed heaters and filters are installed; also an auxiliary exhaust may be turned either into the auxiliary or main condenser or into the feed-water heater. This is true of all machinery except the



STERN VIEW OF THE STEAMER LIGURIA.

steering engine and dynamos, which have independent exhaust. Worthington pumps are installed for all other purposes, capable of handling from 100 to 150 tons per hour. Three double-end boilers supply steam at 190 pounds per square inch, each boiler being fitted with six Morison furnaces. The boilers are placed in a single forward compartment, and the uptakes lead into a funnel the top of which is 85 feet above grates and is 10 feet in diameter. Forced draft is supplied by two 66-inch fans driven by steam engines. The ships are lighted by electricity.

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**Lawson to be Dismantled.**—The famous seven-masted schooner *Thomas W. Lawson,* launched about a year ago, it is reported, will be dismantled and converted into a barge. Her draft will not permit her to enter many of the harbors under sail, and it is reported that she is a bad ship to handle in anything but the most favorable weather.

## RUNNING EVAPORATORS.

BY EARL N. PERCY.

Nowadays almost every seagoing ship is fitted with one or more evaporators, all large ocean steamers and war vessels are equipped with them, therefore knowledge of the operation of this auxiliary is an important part of the marine engineer's education, and the efficiency depends almost altogether upon the care with which it is run. The following remarks are taken from practice and are along the lines of the writer's experience.

The usual form of evaporator is a large, cylindrical vessel for holding salt water, and designed for a pressure of about 50 pounds maximum. Within is placed a coil of pipe supplied with steam from the boilers and discharging into a trap, or sometimes into a second evaporator and then into a trap—in this case the evaporators are termed a double effect. When steam is turned into the coil the salt water is heated up to the boiling point and the vapor is led to the main condenser or filter tank for supplying the boilers or to a small condenser for drinking water. The salt in the water remains in the evaporator and is removed either by blowing out or cleaning out by hand. The evaporator is fitted with baffle plates for dividing the streams of water in the cylinder, a dry pipe for collecting the steam at the top, a water gage, blow valve, steam gage, compound vapor gage, and a salinometer for measuring the density of the water. A separate pump supplies water to the evaporator, and when a distiller is fitted it is generally supplied with a separate circulating water pump.

There are many ways in which an evaporator may be run; some engineers believe in carrying high vapor pressure and low water, while others go to the other extreme of low pressure and high water. Then, again, the feed and blow pumps are run differently, and the evaporator may be piped up in a variety of ways.

When the vapor from the salt water is led to the distiller, all the heat from it is lost and thrown away with the circulating water of the distiller, therefore the evaporator should be run at as low a pressure as is possible. If run at about 26 inches vacuum the boiling point is 124.5 degrees Fahrenheit when total heat above freezing is 1,120 British Thermal Units in one pound of vapor. If the temperature of the ocean water is 60 degrees Fahrenheit, then the heat wasted is 1,120 — (60 — 32) = 1,098 B. T. U. In an average-sized evaporator vaporizing 5,000 gallons of water in twenty-four hours we have 5,000 × 8 1-3 = 41,666 pounds, 41,666 × 1,098 = 45,749,268 B. T. U. of heat required in a day. Now assume coal having a heating value of 14,000 B. T. U. per pound, which fairly represents the best class; assume a boiler efficiency of 60 per cent., and loss due to radiation to be 10 per cent., then assume the efficiency of the evaporator to be 50 per cent., all of which figures are fair average thermal efficiencies as noted in actual practice. Then 14,000 × .60 × .90 × .50 = 3,780 B. T. U. delivered to the vapor for each pound of coal burned. Then 45,749,268 ÷ 3,780 = 12,103 pounds of coal, or over six short tons of coal, are required by the evaporator every twenty-four hours. By proper running this can be cut down considerably.

That evaporation may easily work at low pressures, the distiller should be placed about 30 feet above the evaporator. The condensed vapor will then gravitate to the little air pump usually provided, and the salt water will not be drawn up into the distiller when the evaporator is priming or is flooded.

When the fresh water is needed for the boilers, some engineers run the pressure up to 30, 40, or even 50 pounds, and run the vapor into the receiver of the engine; but this is a mistake, as the heat units were better to transmit direct from the boiler to the engine than to suffer the loss of efficiency through radiation and convection in the evaporator. The better way is to run the vapor direct to the condenser, and operate the evaporator at condenser pressure. Another way is to run the pressure at or a little above the atmosphere, and carry the vapor direct to the filter tank or hot well into the feed water. This saves all the heat, but must be carefully regulated so as to not boil and vaporize feed water where same is open to engine room. Probably the method involving the most practical efficiency is, to condense the vapor in the distiller at a pressure of 10 or 15 pounds above atmosphere, blow the air out of a cock in the top of distiller, and run condensation to feed-pump suction. In this way the feed water from distiller can enter pump suction at a temperature of, say, 245 degrees F., and but 912 B. T. U. will be thrown away by condensation. It is to be remembered that as little heat as possible should be given to the condensing water or other cooling agent.

The next important consideration is the blowing of the evaporator. Usually it is done intermittently, so that the pipes will not choke with salt, and also to flush them. Some evaporators blow direct, like a boiler. Of course, these cannot be worked below atmospheric pressure. Others have pumps to draw out the heavy brine which gravitates to them, and these can be worked at any pressure. Incidentally, a case is known of a young genius who used the evaporator to make the heavy, saturated brine for his refrigerating machine, and he got brine that would float a hydrometer at 96, which is almost impossible in the ordinary way.

The blowpipe should be as straight as possible, as salt is liable to block it at elbows and bends. Attendants with more important duties are apt to forget to blow evaporators, causing saturation, and precipitation of salt, necessitating cleaning. For this reason, as well as to keep up a slight circulation, it is better to have the blow always running a little. As a valve partly open is apt to gather salt, and as a slow-moving pump is liable to stick, it is good practice to have a small pipe to brine suction connecting with clear sea water, which may be used for keeping pump and pipes flushed and full, and thus also thin the brine. It must be so connected, however, that the evaporator will not be flooded when it is running at less than atmospheric pressure.

The blow has a most important effect upon the efficiency, because if it is left open too long the water will run cold and will not vaporize at all. There will be no external evidence of its condition. The gages will stand all right, and the machine will have every appearance of working, and still be below the boiling point and not vaporizing one pound of water. For this reason, one should learn to know the rumble or faint sound of boiling in a properly-working evaporator, and the silence of one in which the circulation is too fast.

If the water is blown too low, so as to uncover the tubes, the salt will be baked on and be very hard to clean off. If the brine gets too heavy, that is, saturated, the salt will precipitate, forming a hard cake in the bottom, choking suction pipes, salinometer cocks, gage cocks, etc. For this reason, it is well not to place these fittings in the bottom, but rather to one side, as such an accident often entails great labor and loss of valuable time at sea. The feed should enter about two-thirds the height of the water level. It should be above the heavy brine in the bottom and below the main body of ascending steam bubbles. In this way the circulation is best maintained.

It is very important that the water level in the evaporator be maintained fairly constant, and this is accomplished by fitting automatic regulating contrivances. One kind has a float regulating the pump throttle; in another the float regulates the suction to feed pump by passing it to suction of blowing pump.

If the feed pump were to suck from the discharge of circulating water from distiller, many heat units could be saved, as this water can and should be discharged very hot, if the distiller is operated properly. The writer has seen the feed pump take all of this water, and thus effect a perfect saving. The circulating water need run only very slowly through distiller. While it has never been, to the writer's knowledge, done, considerable saving could be made by coiling part of the feed-pump suction inside of the smokestack. The distiller setting so high would make this especially convenient, and water could be delivered to evaporator boiling hot, as the temperature of gases in the stack is very high compared to the water.

Electric devices have been tried which automatically regulate the water level, but none have as yet been adopted.

The live steam is usually led to the evaporator at boiler pressure, a drip pipe carrying the condensation from the steam coil to a trap. Many engineers try to force their evaporators by passing steam around the trap. A little reflection will show that nothing is gained by this, as the steam is at the same temperature whether circulating or standing, the trap carrying off the condensation. Moreover, if nothing but condensation is taken away, all the latent heat in the steam is given over to the vaporizing of the salt water. If the evaporator were to work at boiler pressure, the difference of specific heat between salt and fresh water, the low pressure and boiling point in salt-water side, and high pressure and possible superheating of live steam, makes the fresh water vaporized greatly in excess of the steam condensed in evaporator and drained into trap. The amount of heat supplied by the boiler steam equals the amount of heat of the vapor discharged to the distiller, plus the heat given to the salt water, plus the heat lost by radiation.

In making fresh water for boilers only, it is common practice to turn boiler steam directly into the salt-water end of the evaporator. This is a very fast method, especially if the pressure be kept down to the pressure of main condenser, and vapor led there as fast as made. If forced too much, severe pinning and salting of vapor occurs. This method cannot be pursued when potable water is required for cook's tank or scuttle butt, as the oil from boiler steam is always present in sufficient quantity to spoil the taste.

Almost as good results can be obtained from running a properly-proportioned evaporator in the right way. When forced with boiler steam direct, oil fouls the evaporator and hardens the salt deposit, and is very hard to clean out.

In the United States Navy an evaporator of 5,000 gallons capacity per twenty-four hours is required to have a heating surface of 265 square feet in tubes alone, and 66 square feet of condensing surface in the distiller, which the author thinks should be increased to 265 square feet, that the weight of circulating water may not exceed feed water and hence be used for feed water.

At times the vapor in scuttle butt will become salty when evaporator may not have been flooded at all. This may be caused by the leakage of cold brine in the cooling coils. Refrigerating men should look after this closely, as it is very easy for the strong brine to eat a hole in an iron pipe. Another very good way to cool drinking water is to let a small jet of air from the Allen machine, if one be aboard, expand directly into the water at the bottom of the tank, and provide escape at top. Even such a jet from any ordinary compressor will cool the water and remove the flat taste. Baffle and distributing plates should be placed over the jets, else they will rise in a straight line to the surface.

Cleaning the evaporator, if it has to be done at sea, is a most abominable job at best. However, many things tend to ease the task—proper trolley or cranes, so designed as to hold stiff in heavy weather; half-round gouges with long handles to scrape tube; a square-end spade bent to fit bottom and sides of evaporator; and a convenient hydrant for fresh-water hose.

As regards the design of the distillers, the author has yet to see one large enough. They all choke the evaporator, causing it to run up to the highest pressure, thus still further hindering progress. It is perfectly possible for the pressure in the evaporator to equal the pressure in the live-steam coils, and many engineers do this under the mistaken idea that the machine is working at its fullest capacity, when in reality it is at its least.

A more free use should be made of the steam tables and theory of heat in looking up this subject. Aside from the economy, it is of vast importance that the evaporator be run at its maximum on our big passenger steamers, where the potable-water supply is small and large dependence is placed upon distilling plant. It is very serious to have the supply run short, or get flat, or oily, or salty.

Another necessity is to keep the water clear and the tanks clean, that clear ice may be made. Ice shows dirt, etc., because it all collects in the center of the cake. A small charcoal filter is an excellent installment in behalf of the ice man; and air should not be blown through water meant for ice, as it results in porous cakes.

The pumps are usually double-end, piston type, that is, one steam cylinder with a water cylinder on each side of it. The feed end should have metal valves and metal-packed piston, so as to feed hot water when so arranged. There should be no lead or copper here, because they both are slightly soluble in hot water and

might, under favorable circumstances, taint the water. The end for removing the heavy brine should be especially protected against corrosion, and metallic valves used. Any pumps used for fresh water should not have lead or other soluble metal in contact with the water, as the water would be tainted.

When the boiler pressure is above 100 pounds it is the practice to use reducing valves, and use low pressure of, say, 60 pounds in the live-steam coils. This makes very little difference, since, when saturated steam is expended without doing work, or when, in other words, the pressure is reduced, the same amount of heat is present and the steam becomes superheated.

The evaporator nearly always has a safety valve, which, however, is seldom found in good order. Engineers forget that an evaporator explosion at 60 pounds pressure could wreck an engine room, induce larger explosions, and sink a ship, or scald the crew to death.

Salometer pots and cocks are usually provided and seldom used. They should be used freely. A most excellent device is a tube or large water-gage glass with a hydrometer floating inside of it. Every time the glass is blown it fills up with brine from the bottom, and a reading can be taken and the blow regulated for maximum useful effect and at the same time with minimum waste of heat.

Zinc plates should be provided in evaporators as in boilers, to guard against galvanic corrosion. They should be bolted firmly to sides, and bright electrical contact there made. Then a basket or pocket should partially surround them, to catch the zinc salts as they are formed and disintegrated from the plate. Another good practice is to have a water meter on the discharge to the fresh-water tanks. Its use is obvious and invaluable.

The brine and feed pump cylinder should be arranged to take steam from the topmost evaporator coils, to prevent their becoming air-bound. Lastly, but not leastly, shells are usually designed and tested for 50 to 120 pounds pressure, but few are designed and tested to resist the collapsing effect of atmospheric pressure.

The evaporator is merely one of the numerous auxiliaries which a little more study and care would make more efficient, useful, and indispensable to the commercially successful engineer.

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**Inquiry Concerning American Shipbuilding.**—At the regular monthly meeting, held on June 11, of the Maritime Association of the Port of New York, a resolution was adopted providing for the appointment of a committee of five "to ascertain by what method ships built in American shipyards, officered and manned by American citizens, may most quickly and effectively secure the larger part of our foreign carrying."

The committee is to present its report to the board of directors no later than December 1, 1903. The association also declared itself opposed to the enactment of any law compelling sail vessels to carry licensed engineers for the working of the machinery used for handling the sails, anchors, etc., on such vessels, as the enactment of such law would add to the already heavy and unnecessary burdens now imposed upon sail-vessel owners.

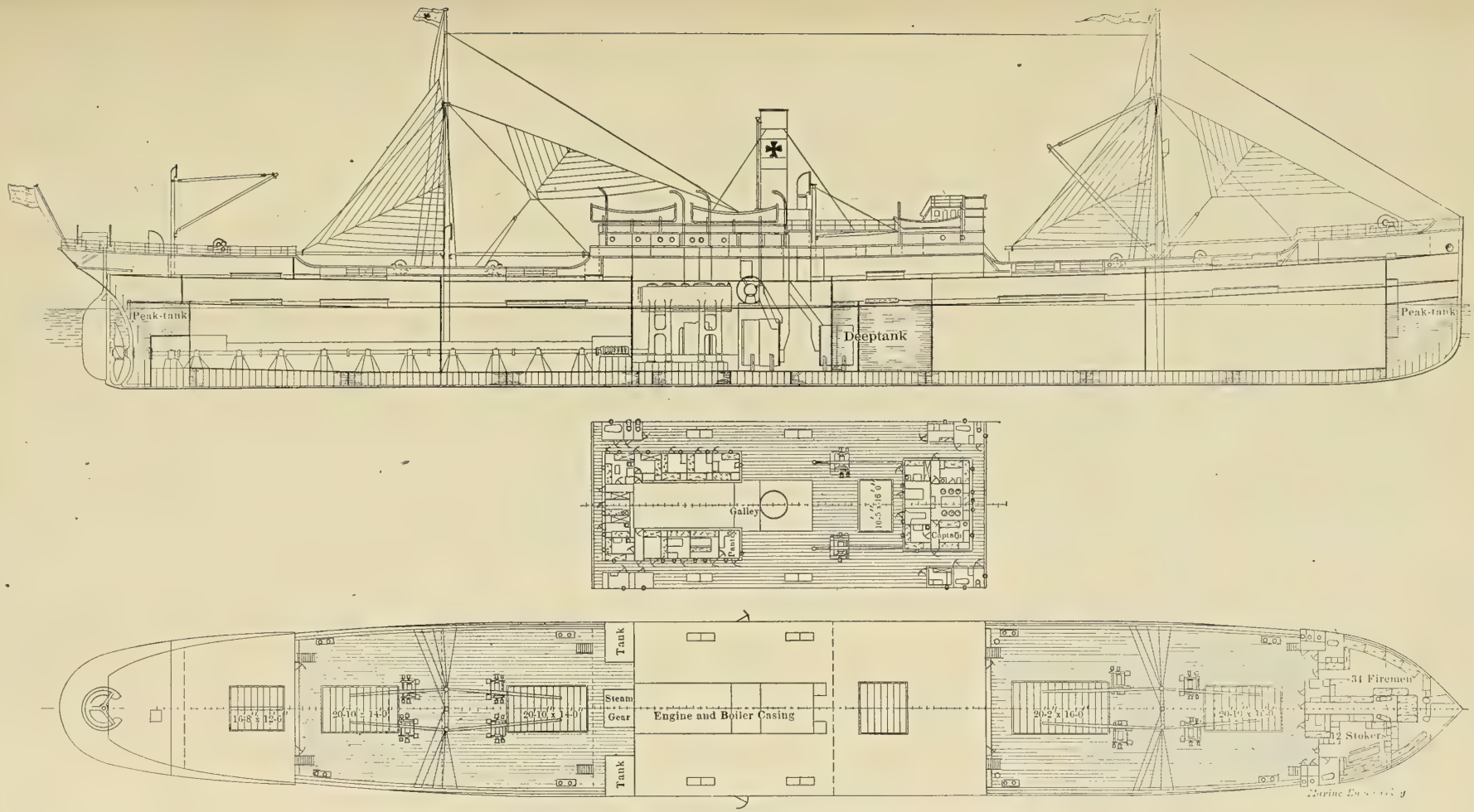
### German-Built Cargo Steamer.

As mentioned in the April issue of Marine Engineering, there are no less than seventy-one shipyards in Germany, some of them capable of turning out large merchant ships and war vessels, and others, smaller sizes, directing their attention to moderate-sized steamers. One of the most modern yards in the country is that at Flensburg, called the Flensburger Schiffbau Gesellschaft. Well located on a fjord of Kiel bay, it has turned out many large merchant ships and vessels of different classes during the last few years.

The cargo ship *Lichtenfels*, built for the Deutscher Dampfschifffahrts, Hansa, Bremen, by the above-named shipyard, embodies the latest practice of large economic cargo vessels. The length over all is 440 feet, the molded beam 53 feet 2 inches, and the depth to upper deck 33 feet 3 inches. The other particulars and dimensions will be found in the accompanying table. The vessel is being built and fitted out according to Lloyd's requirements and is provided with the latest improvements for rapid and efficient loading and discharging of cargo. As will be seen from the drawing, the *Lichtenfels* has a short poop, bridge, and forecastle, with deck house on the bridge with accommodations for the captain and officers. The cargo is carried in four holds and four 'tween decks. Each hold has a large hatch,

**Name**—Lichtenfels. **Nationality**—German. **Type**—Ocean Cargo.
**Launched**—1903. **Builder**—Flensburg Schiffbau Ge'. **Owner**—Deutsche Steamship Company.

| | | | |
|---|---|---|---|
| Length over all | 440 ft. | Diameter of liners | 16 and 19 1-2 ins. |
| " between perps | 425 " | Engine columns | cast-iron, hollow |
| Breadth | 53 " 2 ins. | Type of condenser | surface, built in back framing |
| Depth of hold, to upper deck | 33 " 3 " | Cooling surface | 3,760 sq. ft. |
| Launch displacement | 2,900 tons | Tubes, size | 3-4 in. outside diameter |
| Load draft | 24 ft. 10 1-2 i 1 s. | Air pump | Edward's patent, 28 by 28 ins. |
| " displacement | 12,220 tons | **Boilers** | three single-ended and donkey boiler |
| Dead-weight carrying capacity | 8,000 " | Diameter | 14 ft. |
| Bunker capacity | 1,355 " | Length | 12 " |
| Ballast tanks capacity | 2,070 " | Steam pressure | 225 lbs. |
| **Engine** | four-cylinder, quadruple | Tubes, number | 334 for one boiler |
| Cylinder diam | 24, 34, 51, and 74 ins. | Size | 2 1-2 ins. outside diameter |
| Stroke | 54 " | **Furnaces**, number | three for one boiler |
| Arrangement of cylinders and main engine; H. P.; L. P.; 2d I. P.; 1-1 I. P. | | H. S | 2,167 sq. ft. |
| Designed R. P. M | 65 | G. S | 49 " " |
| H. P | 2,600 | Draft | Howden forced |
| Type of valves, piston and double-ported flat valves | | **Propeller**, number of blades | four |
| Diameter of piston valves | 13 1-2 and 16 1-2 ins. | Diameter | 19 ft. |
| | | Pitch | 20 " |
| | | Developed area | 103 sq. " |




CARGO STEAMER BUILT BY THE FLENSBURGER SCHIFFBAU GESELLSCHAFT, GERMANY.

which is served by two derrick booms and two winches. In the plan it will be noted that the booms are mounted on short masts on either side of center line. Under the forecastle is a space for thirty-four sailors and firemen and twelve stokers. In the forward house, on the bridge deck, there are accommodations for the captain, pilot, a spare state room, and two store rooms and hospital. The special feature of the crew's accommodations on this deck are four small houses built at the four corners of this deck, containing the lavatories of officers and crew and the deck stores. Two winches are placed a little forward of the stack, for serving the hatch going down into the deep tank, which is directly forward of the boiler room. The house round the engine-room casing contains on the starboard side the pantry and mess rooms, on the port side are the officers' quarters, and at the after end the state rooms for engineers, etc. On the poop is placed a derrick mast and winch for loading and unloading the after hold. There are six cargo hatches on the spar deck—two forward, leading into the forward holds; one to the deep tank, as above men-

tioned; two for the after holds and one under the poop. Two fresh-water tanks are placed aft the midship house, each containing 18 tons of water. Hatches are cut through the main deck, of the same dimensions as those in the spar deck, excepting that into the deep tank, where there are two small hatches. Wing and thwartship coal bunkers have capacity on this deck for 347 tons.

The water bottom is fitted from the forward collision bulkhead to the after peak tank. Wing bunkers round the engine and boiler rooms, below the main decks, can stow 310 tons of coal.

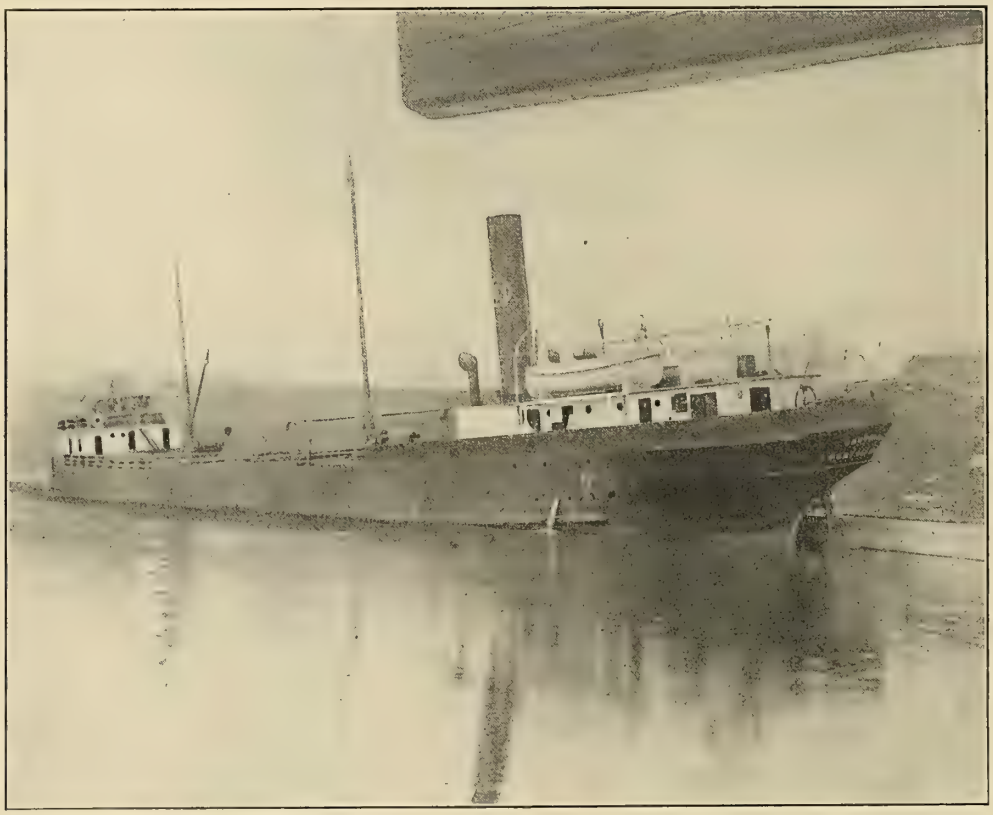
The ship is propelled by one set of quadruple-expansion, four-cylinder engines supplied with steam from three main boilers. A donkey boiler, placed in the recess in the forward bulkhead, may also be run at the same pressure as the two main boilers, namely, 225 pounds, but is installed mainly for taking care of all auxiliaries and the winches when the ship is in port.

**Webb's Academy.**—On June 11 the graduating exercises took place at Webb's Academy for marine constructors and marine engineers, sixteen students receiving diplomas. Addresses were made by Mr. Stephen Taylor, president of the Board of Trustees; Messrs. Harrington Putnam, Stephen M. Wright, and Rear-Admiral George W. Melville. The latter spoke on "Engineering as a Career, and the Attainment of Success." As the engineer is best qualified to understand and perform the largest and most important share of the world's work, he is called upon to act in the administrative capacity in both public and private affairs.

### Steamer Sunk in Canal.

The steel freight and passenger steamer *Wahcondah,* built at New Glasgow, and the first of a fleet of ships for the new Ontario Steamship Company, came to grief at Farrin's Point canal below Prescott during the second week of May, through an eddy causing her stern to sheer while she was in a lock. Her bow struck with great force against the wall of solid masonry, with the result that she was damaged, eleven steel frames and four plates being torn away or bent. The vessel sank immediately in 17 feet of water, which of course, however, did not mean her going under the surface.

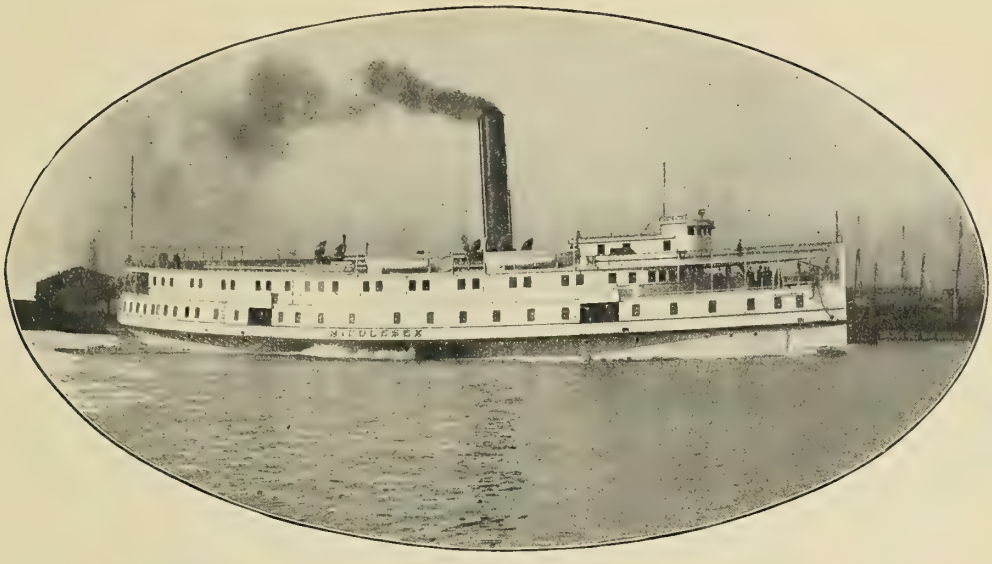
She was loaded with 1,500 tons of freight consisting of firebrick, pig iron, and pickles. The Donnelly wrecking firm, of Kingston, sent the wrecking steamer *Donnelly* and lighter *Grantham* at once to the wreck, and the water in the stranded steamer was quickly pumped out. Divers were then set to work, and when 200 tons of cargo had been removed the damaged part was sufficiently above water to permit of making temporary repairs.



STEAMER WAHCONDAH, SUNK IN FARRIN'S POINT CANAL.

With the pumps still on board for use in case of accident, the steamer proceeded to Toronto and Hamilton to discharge the balance of the cargo, and then went to Cleveland, where she will undergo repairs.

The *Wahcondah* is a new ship, the largest plying between Port William and Montreal, and is designed for carrying packet freight from Duluth to Montreal. The general dimensions are: Length, 245 feet; beam, 37 feet; draft, 17 feet. She is owned by Mackay Brothers and others, of Hamilton.



SIDE-WHEEL STEAMBOAT MIDDLESEX, OF THE WEEMS STEAMBOAT COMPANY.

## NEW STEAMBOAT MIDDLESEX, FOR THE RAPPAHANNOCK RIVER.

The Weems Steamboat Company, of Baltimore, has just put the paddle steamer *Middlesex* on its Rappahannock river route between Baltimore and Fredericksburg, Va., for which she was built by the Neafie and Levy Ship and Engine Building Company, of Philadelphia.

Her principal dimensions are: Length over all, 207 feet; between perpendiculars, 200 feet; beam, molded, 36 feet; beam over all, 59 feet; depth from base line to top of beams at centre, 13 feet; depth at side, from base line to top of guard stringer plate, 12 feet 3 inches; sheer forward, 4 feet 6 inches; sheer aft, 2 feet. The contract called for a speed light of 16 miles, and 14 miles loaded with 50 gross tons of coal and 250 net tons of cargo, on a mean draft of 8 feet. A peculiarity of her construction is that from frame 55 to the stern post, a distance of 94 feet, the keel rises 18 inches.

The general arrangement of the boat is as follows: The space forward of the collision bulkhead is divided by a water-tight deck into a ballast tank of 18 tons capacity and chain lockers. On the lower deck, aft of the collision bulkhead, is a room about 17 feet long, fitted with 18 berths for deck hands and 6 berths in a separate room for stokers. The next 28 feet is the second-class cabin for men, fitted with 45 berths. This cabin, which is reached by stairs under the forward saloon stairway, also contains a room for the steward and one for the waiters and cooks. The hold takes up the remaining space forward of the boiler-room bulkhead. This hold extends under the lower deck to the collision bulkhead. The boiler room is about 22 feet long, extends the width of the hull, and is separated from the engine room by two athwartship bunkers of 60 tons capacity. A passage through the bunkers leads to the engine room, which is 42 feet long. Aft of the engine-room bulkhead are three cabins for women, containing 48 berths, and a room for the stewardess. These cabins are entered by stairs under the after saloon stairway. Under the cabins are two tanks holding 3,500 gallons of water for drinking and culinary purposes. All the berths on this deck are of pipe, and all ironwork is painted with cork. The remaining space aft is occupied by a trimming tank of 24 tons capacity, and is fitted with a water-tight flat forming the tiller room.

On the main deck aft is a large social hall for second-class passengers. The lockers and woodwork as high as the window sills are of oak. Above this the paneling is soft wood painted white. Two toilets and stationary washstands are provided. A passageway leads from this social hall to the freight space. On the port side of the passage are the bar and mail room. On the starboard side are the smoking room and purser's office. The after saloon stairway leads up from the smoking room. Aft of the port wheel box are the package room, ice box, and steward's stores. Aft of the crank room is a large galley, lighted and ventilated by a trunk extending to the hurricane deck. The entire galley and trunk are built of steel, and the floor tiled, making a fire-proof job. On the forward deck is a 6 by 6-inch Hyde steam capstan, windlass, toilets for the crew, and a room for boatswain's stores. The rest of the main deck is used for freight.

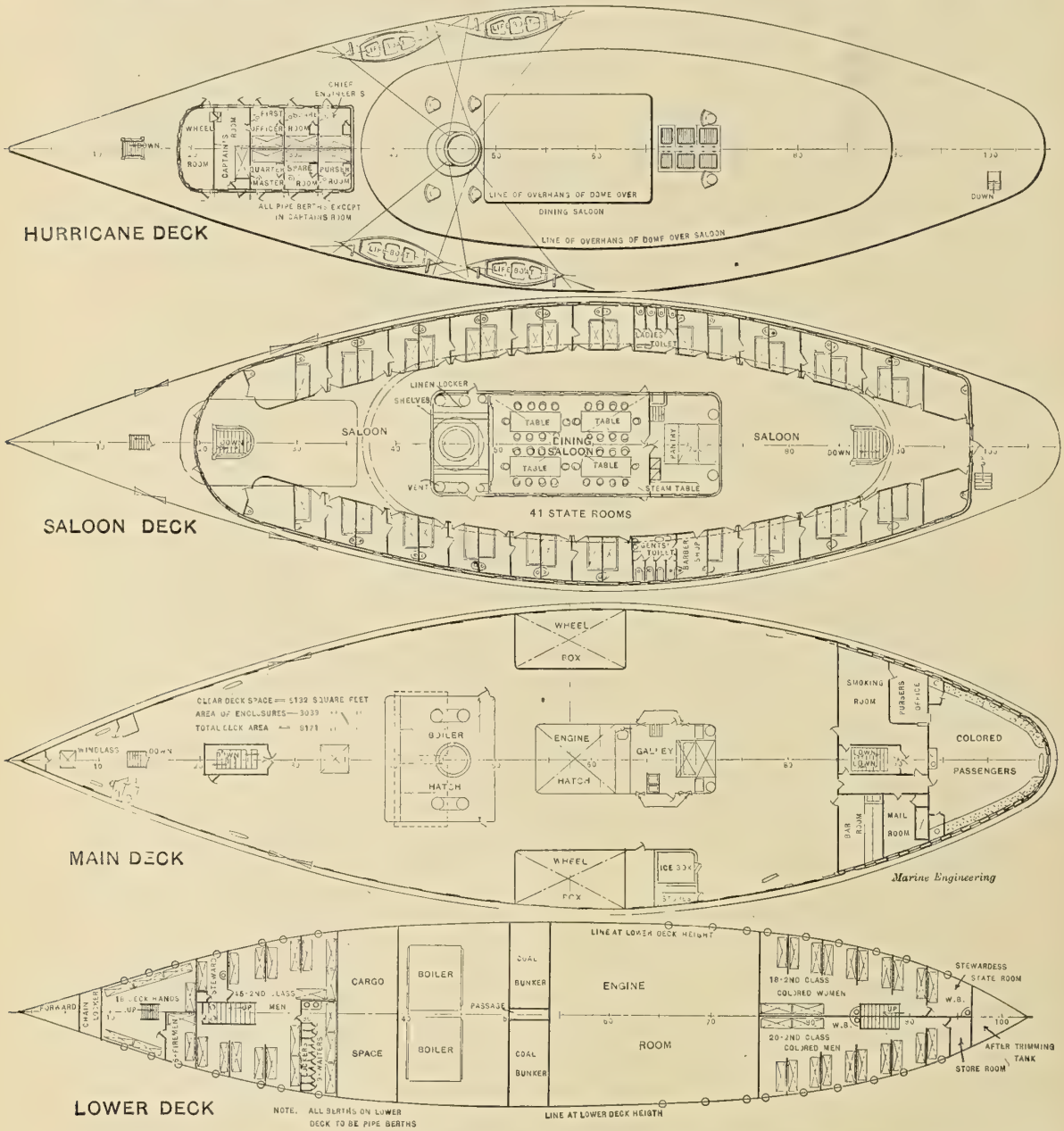
On the deck above is the main saloon, about 150 feet long and extending the width of the boat. The paddle wheel extends only to the under side of this deck. Forty-one state rooms, all outside rooms, open directly into the saloon. Most of these rooms are communicating, and are fitted with two berths each, patent washstands, electric lights, and call bells. The furnishings are of cherry. The four large rooms at either end of the saloon are fitted with double brass bedsteads. The saloon is paneled in oak, and furnished with heavy oak furniture upholstered in green leather. The dome, which extends well forward and aft, is finished in white and gold. A feature of the boat is the dining room, located amidships aft of the stack. This room is 32 feet long by 20 wide, and is raised to a height of over 12 feet by a second dome extending above the saloon dome. It is finished the same as the saloon, and, as at present

arranged, seats 42, although there is room for more tables if necessary. Aft of the dining room and directly over the galley is the pantry, fitted in the usual manner with serving table, dressers, sink, and two dumb waiters. On either side of the stack is a large linen closet.

The hurricane deck extends to the stem, forming a permanent awning over the forward saloon deck. The hurricane deck is open for the use of passengers, and is fitted with slat lockers forward and aft of the lifeboats, of which there are four, and two liferafts. This deck is reached by steps from the forward saloon deck and fantail. The pilot house contains only the wheel connected to the steam-steering gear. The hand gear is located aft on this deck. Aft of the pilot house are the captain's room, and six rooms for the officers, all of whom are berthed here.

The propelling machinery consists of a compound, surface condensing, inclined engine, with cylinders 24 and 53 inches in diameter and 84 inches stroke. The valves are of the double-ported slide type, worked by Stephenson gear with double bar links. The engine foundations are built of plates and angles in the form of box girders. The cranks, which are of cast steel, are placed at right angles. The shafting, connecting and piston rods, and valve gear are of forged steel. The wheels are of the feathering type, 13 feet 2 inches mean diameter, each fitted with nine curved buckets 8 feet 6 inches long by 36 inches wide. The engine was designed to indicate 1,300 horse power at 45 revolutions with 130 pounds steam pressure, and her speed and power in service are found to be practically the same as called for in the design.

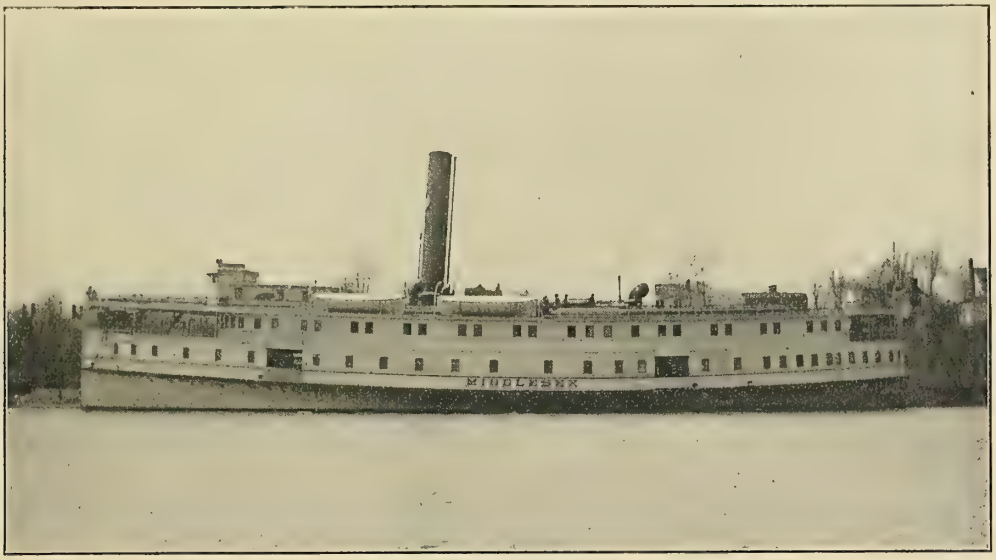
All auxiliaries are independent. The surface condenser,




DECK PLANS OF THE STEAMBOAT MIDDLESEX, BUILT BY THE NEAFIE AND LEVY SHIP AND ENGINE BUILDING COMPANY.

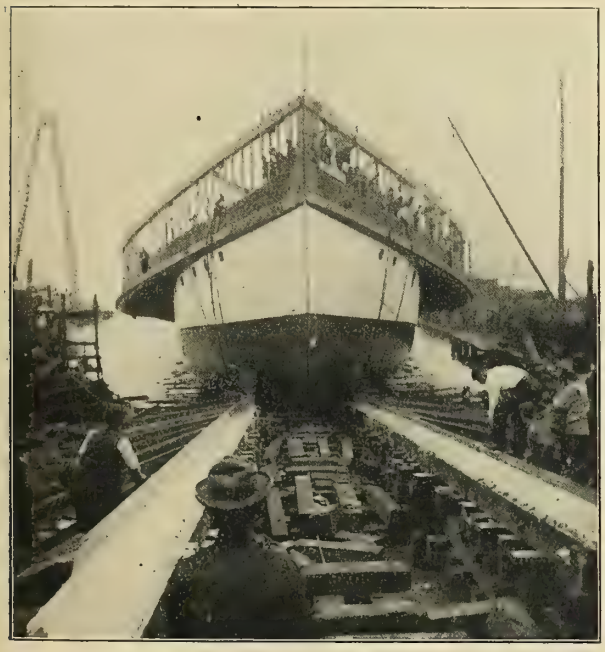
which is cylindrical and built of plates, contains 1,200 5-8-inch tubes 10 feet long. There is a centrifugal circulating pump driven by a single vertical engine, each fitted with three corrugated furnaces 44 inches mean diameter and 6 feet 10 1-4 inches long.

There is also a donkey boiler, 48 inches diameter,




THE MIDDLESEX AT DOCK.

a vertical duplex air pump, bilge, feed heater, and sanitary pumps. In the upper fire room is located a pump for assisting the circulation of water in the boilers. All



LAUNCHING THE MIDDLESEX.

the pumps are of Blake make. A Williamson steam steering engine is located in the forward end of the engine room. The electric lighting plant consists of a 17 1-2 K. W. Bullock generator, direct connected to a horizontal Sturtevant engine. A 14-inch Rushmore searchlight is located on top of the pilot house.

Steam is supplied by two single-end Scotch boilers 12 feet 9 inches diameter by 10 feet 6 inches long, built for 125 pounds pressure, located on the upper boiler-room grating.

NAME—Middlesex. NATIONALITY—American. TYPE—Paddle river steamer.

LAUNCHED—1902. BUILDER—Neafie and Levy S. and E. B. Co. OWNER—Weems Steamboat Co.

| | |
|---|---|
| Length over all | 207 ft. |
| " between perps | 200 " |
| Beam over guards | 59 " |
| " molded | 36 " |
| Depth " | 12 " 3 ins |
| Draft light | 6 " 6 " |
| " load | 8 " 6 " |
| Displacement, light | 725 tons |
| " load | 920 " |
| Block coef., load draft | .526 |
| **Engines**, | compound inclined |
| Cylinders | 24, 53 ins |
| Stroke | 84 " |
| Shafting diam | 12 1-2 " |
| Condenser, surface | 2,022 sq. ft. |
| Paddle wheels, diam. mean, | 13 ft. 2 ins, |
| Buckets, feathering | curved surface |
| Buckets, number | 9 |
| " size | 8 ft. 6 in by 36 ins. |
| " immersion at load draft | 18 " |
| I. H. P. | 1,300 |
| Revolutions | 45 |
| **Boilers** | two Scotch |
| Diameter | 12 ft. 9 ins. |
| Length | 10 " 6 " |
| Furnaces, 3 each, diam. mean | 44 " |
| " length | 6 ft 10 1-4 " |
| Tubes, 676, each | 2 3 4 " |
| Heating surface 2 boilers | 4,150 sq. ft. |
| Grate " 2 " | 130 " " |
| H. S. ÷ G. S. | 31.92 |
| H. S. ÷ I. H. P. | 3 2 |
| I. H. P ÷ G. S. | 10.0 |
| Speed, light draft | 16 miles |
| " load " | 14 1-2 " |

### Suggestions to American Shipbuilders.

The public prints, both technical and lay, are constantly making comparison between the cost of building ships in the United States and in Great Britain. The result of such, expressed in dollars and cents, is invariably against this country, and remedies for such a state of things are as plentiful as the writers of the articles. To the writer of this communication it seems that possibly the fundamental reasons are two and may be stated as, lack of system, and the desire to get more than you are willing to pay for.

The lack of system referred to is shown by the ac ceptance by builders of specifications which do not specify, but leave open to the decision of the inspectors during construction point after point involving hundreds and, in some cases, thousands of dollars.

The second point brought out is shown in the decisions of the inspectors in such cases. Having the power in the absence of specification limitations, and feeling that their employers expect the very best and most expensive, whether required or not by the circumstances and future service of the vessel, the inspectors do not hesitate to use that power to its limit.

It is also an almost universal custom to insert in specifications what may be termed an "omnibus" clause, by which the builder is required to furnish or build any and all items considered necessary, whether or not specified or shown on the contract plans. The inspector is the judge, jury, and sheriff when this clause comes up for trial, as it does very often by the time the vessel is completed. The clause is misused as often as it is properly used, and may be held over the builder's head to browbeat him into furnishing that for which there is no other warrant in either specifications or contract plans.

As a result of this practice the owner gets a much better boat in many cases than he requires, and a better one than the money paid entitles him to, although that amount would have sufficiently paid for all that he needed. In other instances, where the builder has made an allowance for just this sundry item, the loss falls on the owner, who thus has paid for and obtained a yacht when all he wanted was a barge. The builder is "between the devil and the deep blue sea" when called upon to bid on a ship. If he makes his price on the basis of what the owner needs and *seems* to call for by the specifications, he will almost invariably come out of the little end of the horn on reckoning day. On the other hand, if he provides for such conditions in his bid, he will probably lose the contract, as his price is higher than that of others who either ignorantly or knowingly take the chances and trust to Providence to send them a good inspector.

While it would not be advisable to wipe out entirely the omnibus clause nor lock up the inspectors, it does seem as if the former might be so worded and construed as to perform the rightful duty expected of it, and then the inspectors' power should be confined to good workmanship along the exact lines laid down in the specifications. In order to do this it is necessary for the owner to decide in the beginning just what he wants and for the builder to have universal standard specifications for the various parts and appurtenances of ships. Unless all the principal builders will unite in this matter for the general good, it does not seem as though much can be accomplished, for the owner would quickly pass by the builder trying to tie him down in the beginning and go to one more lenient in the matter; but if he found that all responsible builders made the same demands, he would soon adapt himself to the conditions, and in the end come to consider the change to his advantage as well as that of the builder.

The limits of this article must necessarily be too circumscribed to enter into much detail as to what might be done in the line of standard specifications, but a few words can be devoted to the subject with interest and with perhaps some good.

Steel hulls are built usually under the rules of one or more of the classification societies. There are four such whose rules are adopted most generally, *i.e.*, American Bureau of Shipping, United States Standard, Lloyd's Register, and Bureau Veritas. It would, therefore, seem at first blush as though the requirement for standard specifications for this part of a vessel was fulfilled. It will be found that in the specifications, tests, and manner of inspection of the material there is great divergence between the societies. If this could be reduced to a common basis, it would simplify matters at the steel mills, and possibly work in the end to the cheapening of material slightly. There will also be found considerable difference in scantlings required and in the special local requirements. Also, into nearly all the books of rules issued by these societies are interwoven rules which are practically obsolete, while others, if construed literally, are more strict than intended, and oftentimes give to over-strict inspectors opportunities to require more than is intended.

The matter of carpenter work on the general run of ships is more open to trouble on the score of quality of material than any other point. This is especially the case with deck plank. If there were hard and fast standard specifications for the inspection of all lumber, dividing it into various grades, trouble would be avoided by having the standard grade desired embodied in the specifications for the vessel. The standard specifications should also include such lumber as is used for joiner work.

The matter of standards for joiner work would require a great deal of careful thought and work, but when once evolved would be the means of much saving in many cases. Such points as amount of paneling, depth and elaborateness of cornices, overhead ceiling, hard or soft woods, finishing, gilding, panel ornaments, etc., might be left to standardization and still leave room for different ideas of design and proportions. Furniture, such as chairs, tables, and desks, might well be considered under the head of joiner work, so that by having standard furniture the specifications become explicit by stating the exact number of each article to be furnished.

Hull fittings can also be standardized as to general design and material. There would then be various types of air ports, coaling scuttles, bitts, chocks, rails and stanchions, deck stanchions, hawse pipes, steering gear, etc., from which the prospective owner could make his choice.

Under the present methods, specifications often state that the vessel shall be fully equipped and furnished ready for service on such and such a route. Sometimes

this is somewhat but not fully enlarged upon, but not often can anything more than a hazy idea be obtained as to exactly what is wanted. Standards for these items should include several types, graded from cheap outfits to the very best, such as finest hair mattresses, best all-wool blankets, china dishes, silver knives, forks, spoons, etc., best carpets and curtains, etc.

Sanitary fittings, such as bathtubs, closets, lavatories, and piping, are also subject to classification.

The propelling machinery might be readily divided into general classes. Many engines are now in service which have a much higher grade of finish in the way of polish, lagging, brass fittings, etc., than is necessary, or for which the owners would have been willing to pay if the matter had been called to their attention in the beginning. The following headings might be divided into types; boiler fittings, piping and valves (as to what class of pipes could be brass, copper, iron, or steel, and which classes of valves could be brass or iron), auxiliaries (as to how elaborate an outfit, whether pumps be brass fitted, etc.).

Of course, the above is only a general idea, and in the attempt to put into working shape it would undoubtedly be found that a great many departures from the outlined scheme would be advisable.

Under such a system as above the specifications for a vessel would be headed by a tabular statement somewhat similar to the following:

GENERAL SPECIFICATIONS.

| | |
|---|---|
| Steel hull | 20-year A1 |
| Main rail, yellow pine | Spec. No. 2 |
| Main deck plank, Georgia pine | " " 1 |
| Quartered oak | " " 5 |
| White pine for joiner bulkheads | " " 7 |
| White pine for joiner decks | " " 3 |
| Joiner work (quartered oak and white pine) | Type C |
| Air ports, 40 | " E |
| Coaling scuttles, 10 | " C |
| Bitts, 4 | " A |
| Chocks, 4 | " B |
| Life rails, etc | " D |
| Sanitary system | " C |
| Sanitary fittings | " A |

FURNITURE.

| | |
|---|---|
| 3 oak tables | Type B |
| 55 " chairs | " D |
| 5 " desks | " A |
| Bedding | " B |
| Crockery | " A |
| Carpets and hangings, etc | " B |

MACHINERY.

| | |
|---|---|
| Engine finish | Type B |
| Boiler fittings | " A |
| Piping | " B |
| Valves | " C |
| Auxiliaries | " B |
| Lagging and covering | " B |

Such a schedule as this would be of inestimable value to all concerned. The builder would know what to bid on, and what to furnish upon securing the contract. The owner would know that all bids were upon the same basis, and could thus make a fairer comparison and more intelligently let the contract. The inspector would know exactly what his employer expected to get, and, if a lower grade of article or workmanship were called for, could accept it without being afraid of being hauled over the coals for not requiring the best.

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**Naval Engineering Experiments.**—At a meeting of the Engineers' Club, Philadelphia, Pa., held May 2, 1903, Rear-Admiral George W. Melville read his paper on "The Military Importance of Naval Engineering Experiments" and detailed the scope and purpose of the Naval Engineering Laboratory to be established at Annapolis.

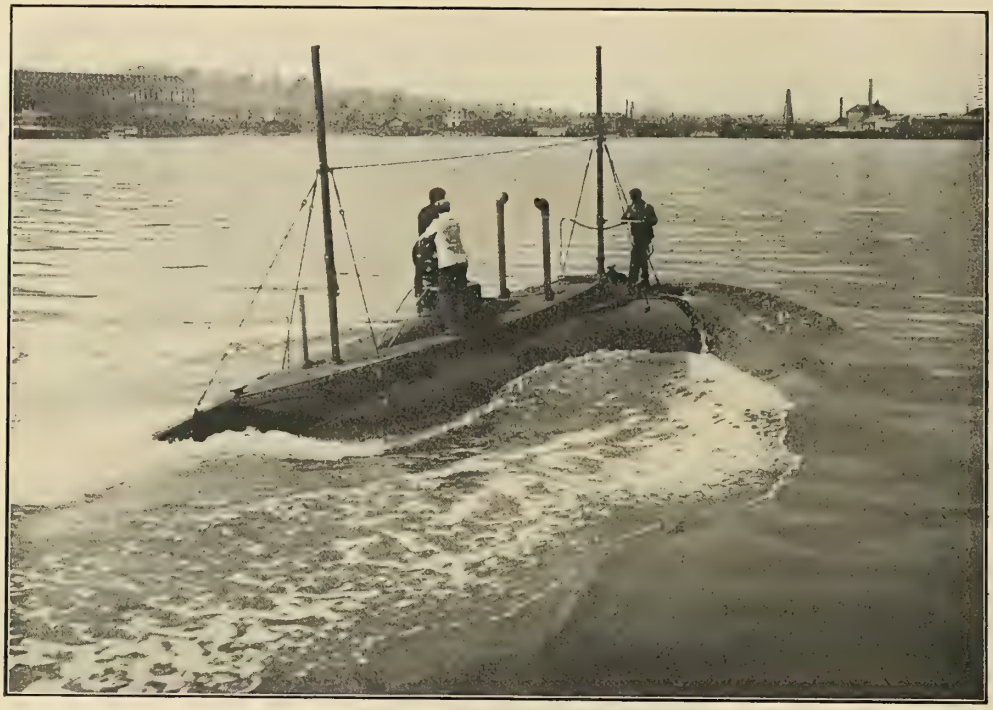
In calling attention to the surprising rise of Germany as a naval and maritime power during the past thirty years, the admiral stated that her excellence in the construction of warships and vessels is not the result of a progressive series of failures in design, construction, or operation. The success of Germany has resulted from study, reflection, and research in the preparation of plans, in the building up and organization of shipyards, and in laying out and carrying on the work of construction. It was the high appreciation of the value of experimental work and investigation that caused the progressive and successful advance.

The naval experimental work of America and England has been done in a desultory and sporadic manner. Thirty-five years ago Engineer-in-Chief Isherwood, U. S. N., carried on an extended and careful series of experiments in connection with the subject of screw propellers. The information secured at that time is standard authority to-day, but the problem as to whether or not in-turning screws are detrimental to manœuvering qualities would have been solved many years ago if the work planned by Mr. Isherwood had been continued. It is methodical, thoughtful, and persistent work which counts, and the engineering world is now beginning to understand the value of the work done at the Charlottenburg laboratory in promoting German success in naval construction.

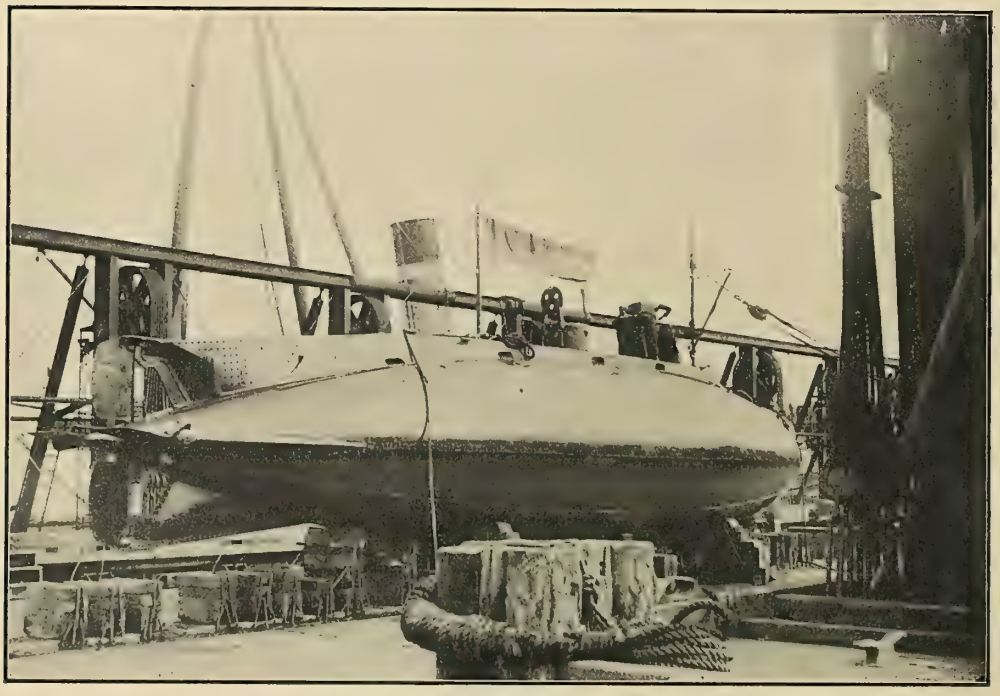
Research should be conducted for preventing, rather than for remedying, evils, and there is not an eminent naval engineer in America or England who is not of the opinion that the establishment of a national experimental laboratory for naval purposes will contribute to military strength. For the past eight years the Bureau of Steam Engineering of the Navy Department has had in contemplation the establishment of such an experimental plant, as it can be absolutely stated that the Navy is behind the times in original work and research. The field to be covered by experimental research along engineering lines is vast, and Admiral Melville gave a few of the many urgent problems, in the solution of which the Navy has a direct interest. The primary reason and chief object for establishing the laboratory is to increase the efficiency of our naval service by preventing the adoption on our ships of war of untried or doubtful devices and expedients.

## TRIALS OF THE SUBMARINE BOATS GRAMPUS AND PIKE.

The waters of San Francisco bay were recently ruffled by two most interesting craft, the first of their kind to be seen on the Pacific. They were the submarine torpedo boats *Grampus* and *Pike,* built at the Union Iron Works under contract with the J. P. Holland Torpedo Boat Company for the United States government. First, considering the general dimensions of these boats, they are 63 feet 4 inches over all, 11 feet 9 inches in diameter, and, when submerged, displace 120 tons. Power for driving the craft when on the surface is supplied through gearing to a single screw by a four-cylinder Otto gasoline engine of 160 horse power; any

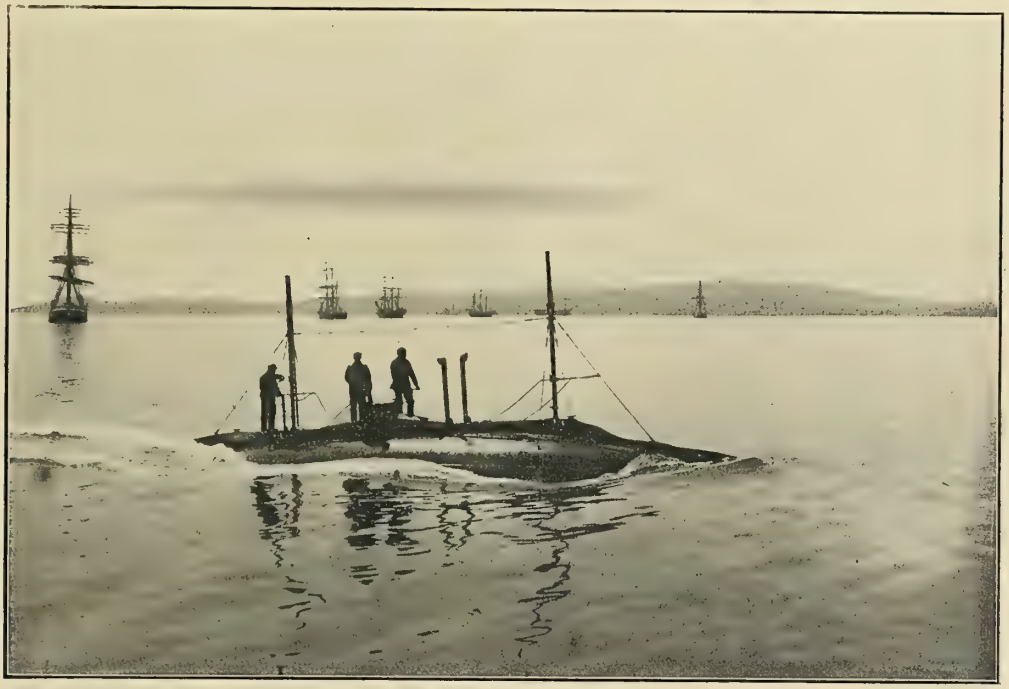


STERN VIEW OF THE PIKE ON TRIAL.

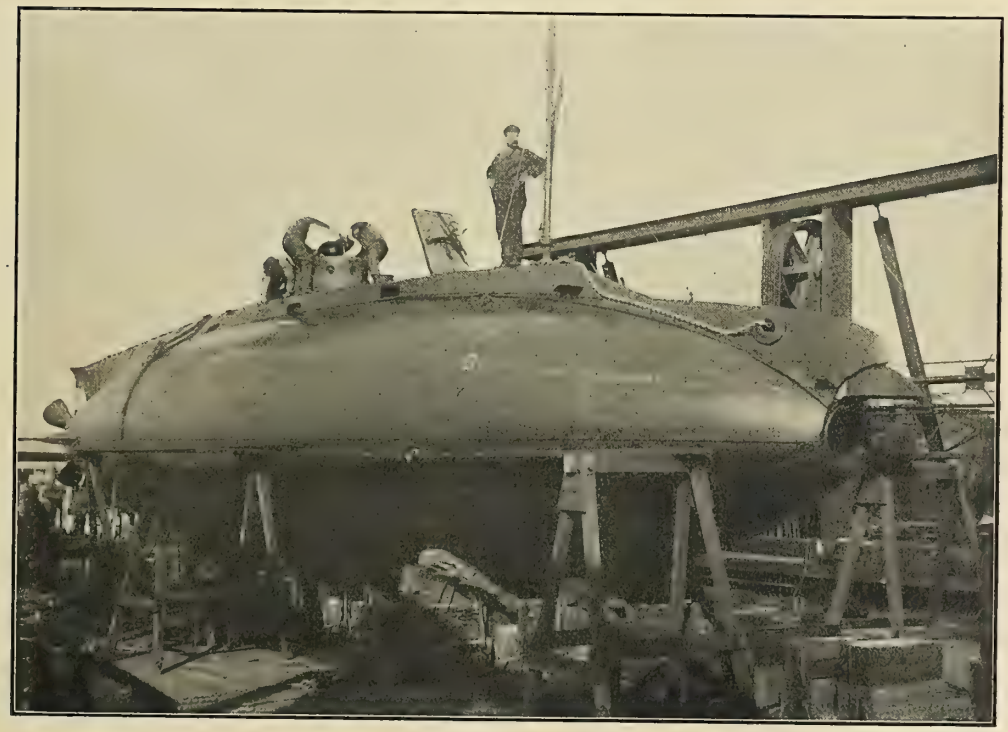


STERN VIEW OF THE HOLLAND SUBMARINE PIKE.

one or all the cylinders may be connected up at a time. When the boat is submerged, a 70 horse-power electric motor is geared to the propeller, the current being supplied from storage batteries rated at 1,840 ampere hours.



THE PIKE RUNNING HER SURFACE TRIALS.



THE HOLLAND SUBMARINES. THE GRAMPUS ON DRY-DOCK, BOW VIEW.

This motor is also used for coming alongside and making landings, as the gasoline engine does not reverse. The trim of the submarines is secured by 3 ballast tanks, one forward, one aft, and one amidships. When the vessel is to be submerged these tanks are filled with water until there is a reserve buoyancy of but 300 pounds, and then submergence is secured by means of diving rudders —horizontal rudders placed at the stern. To bring the vessel to the surface the water is forced out of the tanks by compressed air, and by means of the diving rudders.

In surface and awash conditions the vessel is steered from the deck, while the degree of immersion is

controlled from below by the horizontal rudders. Ventilation for the long periods is reported to be rather bad, as might be expected.

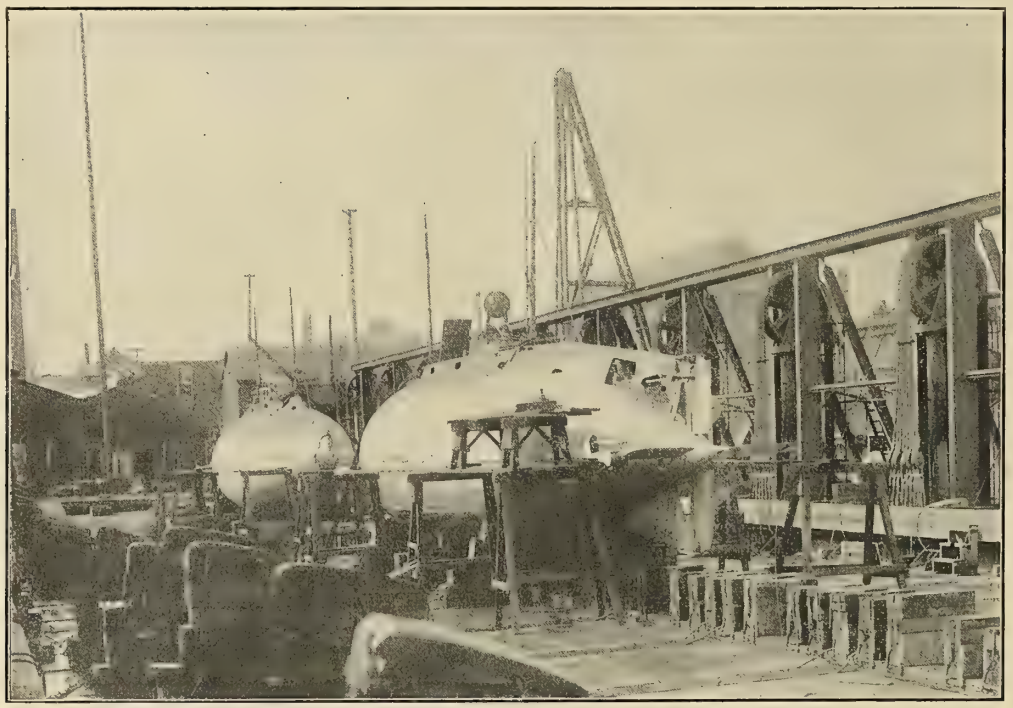
The course laid for the trial extended from a point near the Union Iron Works two miles across the bay toward Hunter's Point. Each vessel was first given standardization runs over one mile and half-mile divisions of the course. The trials, according to the contract, were most rigid, and were for testing the boat under all conditions of submergence. They first consisted, as already stated, of standardization surface runs in light condition, using gasoline engines alone. The contract speed was to be 8 knots, which was exceeded by about half a knot by each vessel. The weather conditions were perfect for these surface trials, as there was scarcely a ripple on the waters of the bay. A standardization run was next made by each awash, with two and three cylinders of the engine connected. The contract required a speed of 7 knots, while on both the *Pike* and *Grampus* the results gave a speed of about 7 1-2 knots. On these trials the boats were trimmed for diving, except that the main ballast tank was empty, the conning tower hatch cover was open, and the after ventilator in place.

The third trials consisted of standardization runs in completely submerged conditions, with the electric motor in operation. A speed of 7 knots was required, and this was exceeded at the first part of the run of each vessel, when the storage battery discharge was greatest. In making this run each submarine was trimmed, so that only the conning tower was visible, before starting on the run. Just as one reached the stake marks it would dive at an angle of about 8 degrees to a 16-foot depth. The course of the vessel could be followed by a little flag on the flagpole, and from this it was evident that the craft was remarkably steady and kept in constant trim. At the end of the run the submarine would come to the surface like a duck, take her bearings, make a turn, and dive upon her return trip. The diving and emerging were controlled by the horizontal rudders.

The fourth trials consisted of a surface run over a course of ten miles, and at a speed of not less than 8 knots. In these trials the *Pike* made 8.55 knots and the *Grampus* 8.47.

Then followed an awash speed trial, when the *Pike* made a speed of 7.65 and the *Grampus* 7.54 knots.

The sixth trial was for testing the torpedo-firing qualities, and, as laid down, each little boat had to run submerged for two miles at an average speed of not less than 7 knots, and fire a torpedo at a target at the end of the run. On April 7 the *Grampus* started on this trial, rising twice en route for observation, and at the end of the run rose to the surface and 25 seconds later discharged her torpedo at the target, 175 yards distance. The torpedo moved in a straight track and passed between the buoys constituting the target.



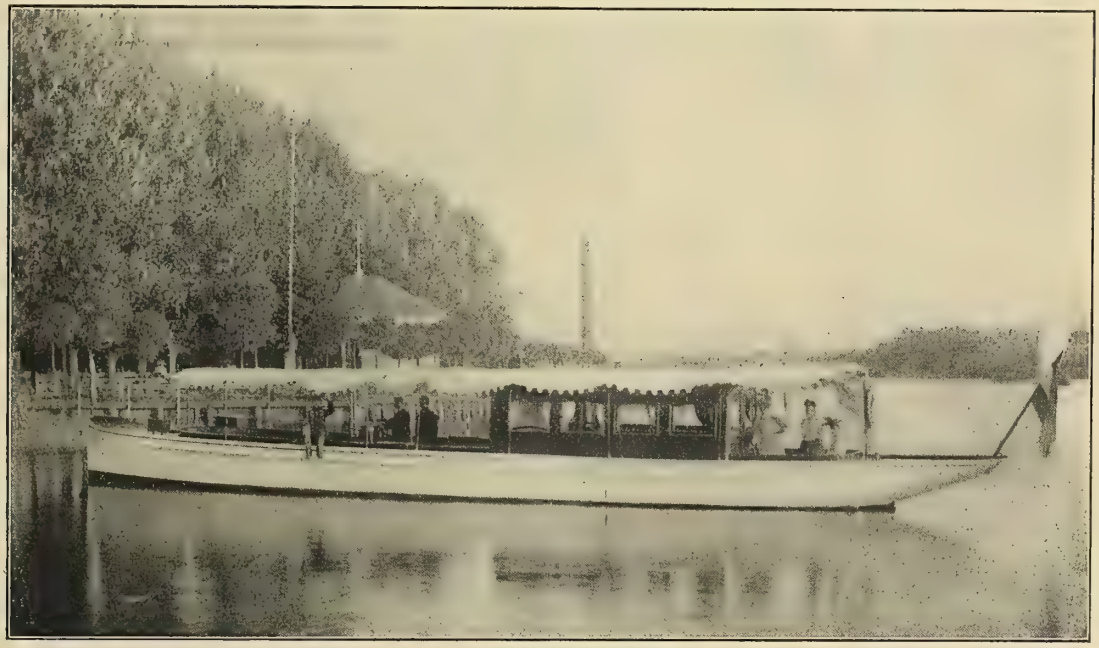
THE GRAMPUS AND PIKE ON DRY-DOCK AT THE UNION IRON WORKS, SAN FRANCISCO, CAL.

On April 4 the *Pike* was run through a similar trial, rising twice for observation, but failed to make a hit at the target, 200 yards distance.

For the two endurance trials the board selected the *Pike* to represent the *Grampus,* as the latter had given most satisfactory results. The trials consisted, first, of a 3-hour, completely-submerged run, under the electric motor only, and at a minimum speed of 7 knots, and then a 12-hour endurance trial for the gasoline engine. The boat was actually submerged 2 hours 31 minutes and 39 seconds, during which time the maintained speed was 7.07 knots; the rest of the time was required for surface observations, which took from 3-4 of a minute to

5 minutes each. The only part of the vessel visible during submergence was the periscope used for scanning the sea ahead. Mirrors are so set that objects ahead are reflected through a tube down below into the vessel, where they may be seen by the navigator.

The first part of the surface endurance run was made with the vessel under way, sailing on the surface, when the engine was disconnected and the electric motor thrown in gear to come alongside of dock. Then the trial was continued with the boat moored to the dock, with all cylinders of the gasoline engine in operation.



ELECTRIC LAUNCH GERMANIA.

## German, English, and American Electric Launches.

BY FRANK C. PERKINS.

### I.

The electric boat and launch industry has been rapidly developing during the past decade, and has now reached a place of importance in Germany as well as in England and America. Many people do not realize the prominent place taken by the electric launch, considering this class of yacht only serviceable with modern expositions. It is true that the expositions have done much to show the beauties of these marvelously clean, rapid, and roomy little boats.

As far back as 1891, at the Elektro-Technischen Ausstellung in Frankfurt a. M., Germany, there were two large electric boats in operation. One of these boats was known as the *Elektra,* and was exhibited by Siemens and Halske, of Berlin, and the other, the *Zurich,* by the Maschinenfabrik Oerlikon, of Switzerland. These electric launches were used for carrying passengers on the river Main, at the Frankfurt exposition, and were much larger than those at any of the recent expositions at Paris, Chicago, or Buffalo.

The *Elektra* was of steel plate construction and was built by R. Holtz in Harburg a. d. E. It measured 37.7 feet in length and 6.6 feet in breadth, and was equipped with a 10-horse-power motor and a Tudor storage battery of 80 elements, with a capacity of 140 ampere hours at a 35-ampere discharge rate. This was a 2.8-ton boat. The *Zurich* was also built of steel, at Zurich, Switzerland, by Escher-Wyss and Company. This launch was 49.2 feet in length at the water line, 52.5 feet on deck by 10.2 feet beam, and was equipped with an 8-horse-power motor operating at a speed of 350 revolutions per minute. The storage battery consisted of 56 elements of the Oerlikon type in glass receptacles. The storage battery had a capacity of 450 ampere hours at an 80-ampere discharge rate, and the boat was able to attain a speed of 5.4 knots per hour. After the Frankfurt exposition was over the *Zurich* was purchased by the Allgemeinen Elektricitäts-Gesellschaft, and was re-named *Elektron.* The Oerlikon storage cells were then replaced by others of a capacity of 350 ampere hours built by the Accumulatoren Fabrik A. G. of Berlin.

Two smaller electric launches, the *Watt* and *Matilda,* were constructed for this concern, 28.9 feet in length, 6.2 feet beam, and each was equipped with a 3-horse-power motor; each battery consisted of 46 elements of a capacity of 150 ampere hours at a 30-ampere discharge rate.

It may be of interest to consider some of the details of construction, with drawings and photographs, as well as electrical connections, of some of the more modern boats constructed in Germany by the last-named company; in England by the Thames Valley Launch Company, Ltd., of Weybridge, Surrey; and in America by the Electric Launch Company of Bayonne City, N. J., showing characteristics, outlines of the yacht, and the arrangement of the electrical equipment. The German builders of electric launches adopted two or three methods for the control of the electric motors. One of these consisted of an electrical controller mounted in such a position that its shaft is horizontal, the wheel by which it is manipulated being mounted on a shaft which is

concentric with that of the steering wheel. Another method of control, particularly for large boats, is that using a lever which is thrown forward or back, according to the motion of the boat desired. A form of switch is also used with a vertical shaft, to which the contacts are fastened, the handle traveling in the arc of a circle.

The Hamburg harbor police and the Hamburg-American Line have electric launches similar to the *Marie,* length over all, 39.4 feet; beam, 6.9 feet. The *Marie* is in use upon the river Weser at the port of Bremen, and is equipped with a 12-horse-power motor and 92 cells of storage battery.

The electric launch *Oder* is 38.1 feet in length, has a breadth of 7.6 feet and a draft of 3.3 feet. It is in use on the river Spree near Berlin, and has a motor of 8-horse-power capacity. These electric boats are extensively used for Berliner Wasserbau-Inspection. The storage battery equipment of this boat includes 80 cells, having a weight of 4,580 pounds, with a capacity of 15-horse-power hours at a one-hour rate, and will develop 2.4 horse power for 10 hours.

Another electric boat, named the *Spree,* is used at Berlin for river inspection service. It is equipped with a 4-horse-power motor which is operated by 80 storage cells of the same capacity as the *Oder.* The dimensions of the launch are: Length over all, 30.3 feet; beam, 5.8 feet; and draft, 2.3 feet.

At the Hamburg port of the river Elbe a well known crane company operates the electric launch *Quaiverwaltung,* which is equipped with a 12-horse-power electric motor and has a draft of 3.1 feet. It has a total length of 40.7 feet over all, with a beam of 7.6 feet, and the storage battery installation consists of 200 cells.

The *Germania* is a much larger boat than those previously described, and is equipped with a 50-horse-power electric motor. It has a length of 64 feet, with a beam of 9.2 feet and a draft of 2.9 feet. The displacement is 17.5 tons, and it is equipped with 90 cells of storage battery having a capacity of 450 amperе hours at a 6-hour discharge. The maximum discharge rate for these cells is 150 amperes.

Among the other recently-constructed electric boats may be mentioned the *Nimpf,* built for Herrn Van Houton, of Weesp, near Amsterdam, Holland, and the *Havel,* which is in operation on the Potsdam lakes near Berlin. This launch is equipped with a 4-horse-power motor; is 29 feet long over all, 5.8 feet beam, and draws 2.6 feet of water.

A number of electric boats have been constructed in Germany for the harbor inspection at Rotterdam, Holland, and Stockholm, Sweden. One of the latter is a large boat known as *Tre Kronor.* It has a total length of 20 metres, and is equipped with a 20-horse-power motor. The battery consists of 45 cells, and it has a total displacement of 67 tons. The speed of the motor is 6 knots per hour, and the battery will supply 13.5 horse power for a period of five hours.

Without question there is a wide field for electric boats in connection with the navies of the various countries, as well as the police, customs, and harbor inspection departments of cities located on important bodies of water. There is also a wide field for this class of boat as pleasure craft, and at present they are being more largely used for this service.

## Replacing a Slide Valve with a Piston Valve.

BY J. P. BADENHAUSEN.

It is generally recognized that piston valves are superior to flat slide valves in the high-pressure cylinder of a modern triple-expansion engine, even if a flat slide valve is supplied with a relief frame on the back and a balance piston to assist moving the valve.

Of course, speaking from the economical standpoint of steam consumption, the flat slide valve reduces the cylinder clearance considerably beyond that obtained by the piston valve, but for minimum of repairs and all-around good working the piston valve is superior to the slide valve. There is running to-day to the port of New York a steamer of 3,500 tons, built by one of the best English shipyards, which has an engine of 2,500 I. H. P., the high-pressure valve of which was a flat slide valve. The particulars are as follows: The engine is a three-cylinder triple-expansion, with cylinders 26 1-2, 45 1-4, and 75 inches diameter by stroke of 48 inches and revolutions 80 per minute. The boiler equipment consists of two 3-furnace single-end Scotch boilers, 15 feet diameter and 12 feet long, equipped with the Howden system of hot forced draft; steam pressure is 180 pounds gage.

All valves on the engine cylinders were of the double-ported, flat slide valve type without relief frames on back, having balance cylinders on the intermediate and low-pressure valve stems to assist. The high-pressure valve stem was without a balance piston even. The valves are driven by Hackworth's gear. The pressures in the valve chests are as follows: 180 pounds in the high-pressure, in intermediate receiver 65 pounds, and 15 pounds in the low-pressure receiver.

The size of the high-pressure valve was 27 by 20 inches, with an area of 810 square inches, and the pressure on the back of the valve was approximately 180 pounds—65 pounds=115 pounds per square inch. The total pressure on the back of the valve is therefore 115×810 square inches=93,150 pounds, or 46 1-2 short tons, and the throw of the valve, or valve travel, was 6 inches. In the Hackworth gear, as with nearly all radial gears, the connecting rod from the slipper to the end of the valve stem is very long, and in this particular case the action of the engine was very peculiar under different circumstances. When the engine was turning up at full speed and the valve was allowed to run without cylinder oil, this long connecting rod would vibrate and the valve would grunt in such a manner as to cause the decks, and the whole ship in fact, to vibrate in unison with it, and sleep for the landlubbers on board was next to impossible. The engine would slow down as much as seven revolutions.

When cylinder oil was used, and used copiously, the difficulty would disappear and the engine would speed up. Of course, this oil passed into the condenser and the boilers, with the result that the condenser would in a year's time become so dirty as to necessitate the drawing of the tubes for cleaning, while the oil in the boilers was conducive to priming and eventually caused trouble. To decrease the friction of this slide valve, the makers in England sent over a new valve, which had the face full of 7-8-inch dovetailed holes filled with white metal. This is an old trick, but worse than useless, as was proven.

The minute the engineers failed to supply the engine with cylinder oil, the large friction of the valve upon the false face produced immense heat, which resulted in melting out the white metal, which was carried to all parts of the three cylinders and chests. The friction area being produced through the loss of the white metal, the valve worked harder and harder, and at the end of four months had to be renewed. After that a new slide valve was fitted every eight months, which in itself was quite an expense. It was suggested to substitute a piston valve for the flat slide valve, but there was one drawback, namely, the slide valve was double-ported; and double-ported piston valves, while they may do in land engines and electric light machinery, are not considered good for marine work. How the problem was eventually solved, and with the use of a single-ported piston valve, was as follows:

cannot be exceeded, as the center line of the valve stem must remain the same.

In most cases where piston valves are put in place of flat valves, the plug valve is the best to be used; and if so, then, as said before, the areas for the steam reaching the top and bottom plugs must be ample. The exhaust is taken care of by the middle part of the cage, and it was not necessary to restrict the areas.

The piston valve was designed to meet the same conditions as the flat slide valve, the throw of the eccentric remaining the same, and the travel of the valve being 6 inches, steam lap and exhaust lap to be the same as before.

The valve and its details are the same as are generally met with and need no description. As there was no bonnet on the old slide valve, means had to be adopted for getting the valve in place. The top of the

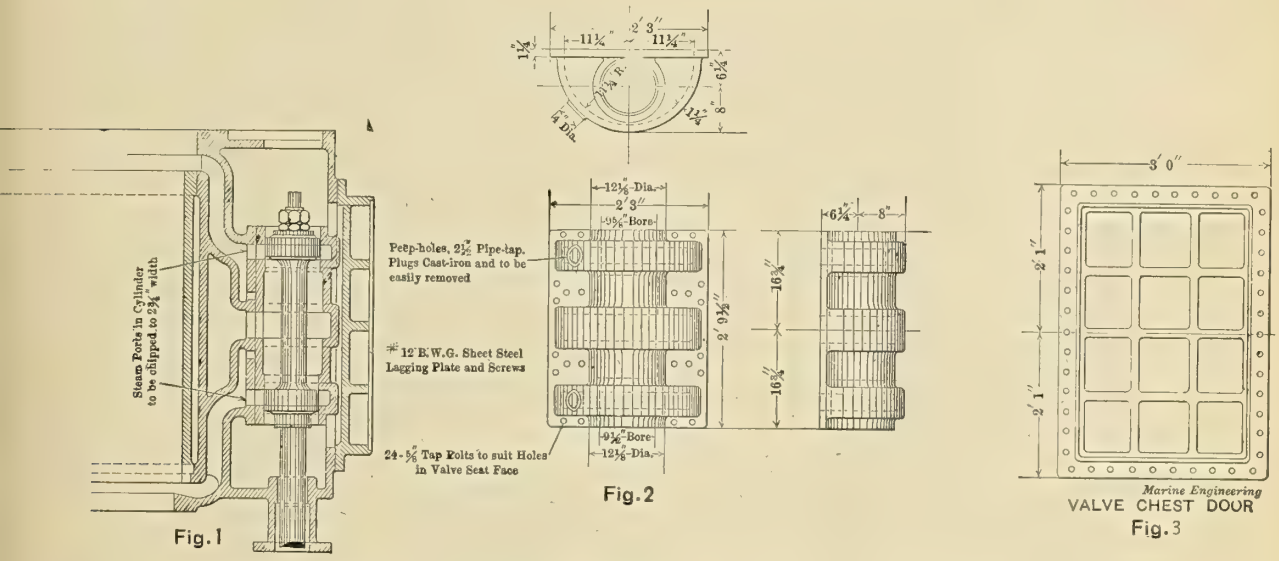



Fig. 1 Fig. 2 Fig. 3

VALVE CHEST, VALVE, AND DOOR OF A HIGH-PRESSURE VALVE, USED TO REPLACE A SLIDE VALVE.

The cylinder and valve gear up to the valve stem were to remain as before, and the center line of the valve stem was not to be changed. Also, the piston valve was to be single-ported, to take steam at the ends and exhaust at the middle, and was to be put in in such a way as to be drawn out at the top in the ordinary manner. Figs. 1 to 3 give the detail drawings. The steam ports in the cylinder were each 1 3-8 inches wide.

The false face was taken off and the top and bottom ports chipped to be 2 3-4 inches wide each. The valve cage, Fig. 2, was bolted on the cylinder in the place of the previous false face, and the cage covered up the ports near the middle line of the cylinder; thus only the ports on the top, each 2 3-4 inches wide, were open. This cage was fastened to the cylinder by 24 tap bolts, 7-8 inch, fitted into the holes already in the cylinder. In designing such a cage care must be taken to leave steam passages at least equal to the area through the steam ports, so that there will be no wire-drawing. Peepholes are placed to assist in setting the valve.

The calculated diameter of the piston valve is 9 1-2 inches, which compares favorably with other engines having the same particulars of engine. This diameter valve chest was cut away with a boring bar, and a 10-inch hole made, which allowed ample room for inserting or drawing out the new piston valve. A casting was bolted on top of the valve chest, the joint being a permanent one, and held on with eight 1-inch through bolts through the valve chest top, and five 1-inch tap bolts to the flange. A round cover was fitted on top of this casting in the regular fashion, and held down with eight 1-inch studs. If it is necessary to draw out the valve for overhaul, the work may be done in the same way as if the cylinder never had anything but a piston valve. With these new changes made, a new flat slide valve will be saved every eight months, the oil consumption will be cut down to one-fifth, and the engine will make at least five revolutions more than when the slide valve was in place. Nowadays, with the high steam pressures in vogue, it is necessary to run across a job like this ship to find out the difference in working and expense between a flat slide valve and a piston valve.

**Liquid Fuel.**—The British cruiser *Bedford*, it is reported, is having eight boilers fitted for burning oil fuel.

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At the time when the formation of the United States Shipbuilding Company was announced reference was made to the fact in these columns, and to the field of usefulness which would seem open to such an organization, equipped as it was not only for the building of ships, but for the making of guns and armor as well. The most skillful of the plans of modern financiers, however, have in them something of the experimental and something of the unknown, and it now appears that the plan of organization first adopted was not the best suited to the needs of the situation, and at least two plans of reorganization have recently been proposed for the purpose of placing the company on a better basis for carrying on its business. It appears that from the first the company was compelled to make advances to its constituent companies from time to time of most of the cash in hand to meet the various demands for cost of operation and for working capital. It appears, further, that by reason of large mortgage obligations its credit has become impaired, so that some new adjustment is required in order to meet outstanding obligations and to provide for carrying on its business.

Shipbuilding, especially, is a business calling either for a large reserve capital or for excellent credit. Returns come irregularly, and sometimes at long intervals, while the outgo for labor and material must be sure and continuous. Under these various circumstances it is not surprising that the company has been brought to face the need of some readjustment which shall better suit the situation than did the original organization.

Undoubtedly one of the serious difficulties with such organizations lies in the temptation to capitalize on the basis of earning capacity rather than of actual value invested in the plant. This is a temptation hard to resist in times of business prosperity, when the earning capacity is large and corresponding dividends seem well assured. It is, of course, unnecessary to point out the danger and unreality of capitalization on such a basis. In the present case the fact that the original capitalization was for about $82,000,000, while in one of the plans for reorganization the proposed capitalization was but $43,000,000, shows at least a wide divergence in the basis of capitalization in the two cases.

Connected with this general question of the combination of shipyards is that of the trade condition and outlook at the time. With the yards full of work and more offering, perhaps almost any form of organization would be suitable; but with the yards working at only a fraction of their capacity, and with the outlook for the future somewhat uncertain, if not depressing, only the most judicious and conservative form of organization could hope to be adequate and safe. There is no doubt that the trade situation has had its influence in bringing about the troubles with which the United States Shipbuilding Company has had to deal. Unless we are mistaken, the amount of work in its yards as a whole has steadily decreased from the organization of the combination. That is, new contracts have not been forthcoming in sufficient quantity to offset the completed work, and the outlook for the immediate future is none too encouraging. Just now, indeed, outside of government work, the yards on the entire Atlantic coast are only occupied to a small fraction of their capacity. This general trade condition, which, on the whole, has not improved since the organization of the company, has doubtless greatly complicated the problem of a satisfactory form of combination for shipyards doing business under the conditions as they prevail in the coast yards at the present time. Whatever may be the ultimate solution, it is clear

that the present shipbuilding situation and outlook is not one which will bear any inflation or capitalization on an artificial basis. With fixed charges based on the value of the investment actually operative and fruitful, with dead wood pruned away, with a series of constituent companies each sound in itself and carefully managed in detail, with a conservative and wise central administration, with a reasonable amount of work offering to keep the various constituent companies advantageously occupied—with these various conditions fulfilled there seems no reason why a shipbuilding combination should not be as successful as any other like business aggregation; and with constituent companies having the varied possibilities of the United States Company, there seems every reason for predicting for such a combination a career of usefulness and success. We trust that the troubles in connection with the present combination will not react disadvantageously on the constituent companies, and that whatever the outcome of the plans for reorganization, the results may be such as to affect favorably the trade situation as a whole.

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THE dependence of the shipbuilder on the maker of the material which he must use has been frequently referred to in these columns, and we have pointed out the great need of some better commercial relation between the two in order that the builder may obtain his material within some reasonable approximation of the date when needed. These remarks have referred chiefly to mild steel material in the form of plates, shapes, etc., as used in hull construction. At the present moment we desire to call attention to another class of material, cast steel, in which there is great difficulty not only in obtaining desired delivery, but with the quality of the material as well. The question of delivery on time is part of the general trade situation in the steel business, and can only be corrected by a more evenly balanced relation between supply and demand, while in the meantime the builder is the one chiefly to suffer. We desire here to call attention rather to the quality of such material, sometimes so poor as to be of no use after delivery, such defects often not appearing until a considerable amount of work has been spent on the piece in the shops.

Aside from the question of test strength and the rough and seamy appearance of steel castings, the chief trouble arises from small concealed blowholes, sometimes in such great numbers as to render the piece quite useless for the purpose desired, and only discernible after a considerable amount of time and labor has been expended on them. It is true, of course, that the art of steel casting is one of the very greatest nicety and difficulty, and that there are some steel foundries where such art is well understood and where the product is quite uniformly satisfactory. It is no less true, however, that there are other foundries where the art is less perfectly understood, or where press of business leads to a neglect of some of the needful precautions, with the result that the attempt to use cast steel only too often becomes the source of most vexatious and costly delays. It is not alone in large pieces that such trouble is met with. In fact, it would seem to be on the whole more commonly found in small pieces, where perhaps the small size and simplicity of form may have led to some relaxation of the precautions taken with larger and more complicated pieces. Be the explanation what it may, the fact remains that in some yards there is observable a reaction against the use of cast steel and a tendency to return to the heavier but more reliable cast iron. Difficulties of the character mentioned have been met with largely in pipe flanges and fittings, small parts of the engine, such as link blocks, crosshead slippers, pillow blocks, and even in pistons and other larger items.

The situation itself is perfectly clear, and it is very unsatisfactory to the builder of marine machinery. The problem of what should be done is less easy of solution. From the results which are obtained from some of the leading steel foundries it appears that satisfactory and reliable material can be provided; there is no physical impossibility in the way, and it only calls for a proper observance of all the conditions needful. From the standpoint of the builder, therefore, the poor results seem to be due either to incapacity or to carelessness, or perhaps to both. What is very much needed is such improvement in the process of steel casting as shall make readily possible the production of a thoroughly reliable product without undue increase of labor or time involved. The demand of the hour from this particular point of view is for a product which shall fill the needs for which cast steel is now employed, and which shall be as reliable and uniform in character as the better grades of cast iron or brass. The cast steel founder who can fully realize these requirements, especially for small parts, and at what shall seem a fair price, will be justly considered a benefactor to the engineering public, and they will be only too willing that he should make the fortune which would be his just and certain reward.

## Death of Henry G. Morse, President New York Shipbuilding Company.

Henry G. Morse, president of the New York Shipbuilding Company, Camden, N. J., was stricken with apoplexy in the office of J. P. Morgan and Company, in Wall street, on the afternoon of Tuesday, June 2. He was removed to the Astor House, and died there in about a half hour.

Mr. Morse went to Mr. Morgan's office at about 2 o'clock, and, after talking with Edward T. Stotesbury, a member of the firm, went away. He walked a short distance up Wall street, met a friend, and with him returned to Mr. Morgan's office and asked to see Mr. Stotesbury again. He was shown into a back room, and, when Mr. Stotesbury came in, complained of feeling ill and faint. A doctor was called, but Mr. Morse's condition became so serious that a private ambulance was summoned, in which he was taken to the Astor House. Oxygen was administered on the way to the hotel, and when he arrived the house physician was called in, but, in spite of the efforts of the physicians, Mr. Morse died soon after he reached the hotel.

Mr. Morse was born in Poland, Ohio, in 1850, his father coming from New England and his mother from Virginia. He graduated in 1871 from the Rensselaer Polytechnic Institute, Troy, N. Y., and entered the employ of the Pennsylvania Railroad as assistant engineer of the Allegheny Valley line. From 1873 to 1878 he was assistant engineer of the Wrought-Iron Bridge Company, and from the latter date to 1887 he was senior partner of the Morse Bridge Company, Youngstown, Ohio, contracting railway and highway bridges. He next became president of the Edgemoor Bridge Works, Wilmington, Del., which position he held until 1896, when he resigned to accept the presidency of the Harlan and Hollingsworth Company, of the same city.

Two years later Mr. Morse resigned from this company to undertake the designing, construction, and operation of the new shipbuilding plant which was later named the New York Shipbuilding Company and located at Camden, N. J. Twelve months were spent in preliminary work in developing designs, securing the necessary capital, and in seeking for a proper location, and in July, 1899, the actual construction of the plant began, and was carried on at such a rapid rate that in November, 1900, the keel of the first ship was laid.

Up to the time of his death, Mr. Morse had secured for his company twenty contracts, seven of which have since been completed and delivered, and one was ready for delivery at the time of his death. These ships range from 300 to 615 feet in length, consisting of cargo carriers, oil-tankers, freight and passenger steamers, and several classes of government work. Mr. Morse was a member of numerous engineering societies, among which were the American Society of Mechanical Engineers, American Society of Civil Engineers, American Institute of Mining Engineers, Society of Naval Architects and Marine Engineers, all of New York, N. Y.; the Institute of Naval Architects of London, Union League and University Club and Engineers' Club of New York, N. Y., and the Union League Club of Philadelphia. Mr. Morse leaves a widow, three sons, and three daughters.

Herewith are appended resolutions adopted by the Board of Trustees of the New York Shipbuilding Company at a special meeting held June 6:

Since the last meeting of this board a great misfortune has befallen this company in the death of our president, Henry G. Morse, which occurred in New York city, where he had gone in the performance of his duties as president, on Tuesday, June 2, 1903, at 3.30 P.M. The remarkable ability and the undoubted honesty and integrity of purpose which Mr. Morse had always displayed in the discharge of his duties as president of this company, and his faithfulness in its service, demand our warmest expressions of esteem and confidence; and true recognition of the value of his services, of his wonderful talent as an organizer, clearness of conception in inaugurating and carrying out to a successful termination the great plant which was the entire conception of his brain, and which will always stand a monument to his memory, demands our most sincere and unqualified recognition and our deepest regret and sorrow for his death.

HENRY G. MORSE.

He was a man of tireless energy, of kindly and engaging manner, and he had so endeared himself to the officers and employees of the New York Shipbuilding Company that he had created a harmony of feeling and a unity of action among them which will continue to be a marked advantage to this corporation.

*Therefore be it resolved,* That the directors of this company tender to Mrs. Morse and her family their assurance of profound sympathy with them in their great loss; and

*Resolved,* That a committee of three be appointed by the chairman of this meeting to procure a design for a bronze tablet to be erected in some advantageous position in the plant, upon which shall be placed a suitable inscription commemorative of Mr. Morse's great services to the corporation, and that such committee make a report at the next meeting of this board;

*Resolved,* That a copy of these resolutions be entered upon the minutes of this company and sent to the family of Mr. Morse.

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Mr. De Courcey May, formerly general manager, has been elected president of the New York Shipbuilding Company.

### Lubrication.

*Editor* MARINE ENGINEERING:

I have read with much interest Mr. Nye's article in the June number of MARINE ENGINEERING dealing with methods of testing oils, and, being in the oil business myself, I would like to present the other side of the question.

No doubt there are many engineers who are fully competent to make such tests, and who are sufficiently unbiased and unprejudiced to reason with, but I must say that, judging from my experience, I believe that if you placed a set of oil-testing apparatus in the hands of all engineers, many of them would have some special requirements for a lubricant. Thus, one engineer will want such a flash point and such a viscosity, and no amount of argument can convince him that oils of any other tests are as good, while the second engineer may require what the first one would not use. Thus the number of grades of oils that the oil companies would have to supply would be almost unlimited.

It is impossible for every engineer to become an expert in the question of oils. Now, at our works we have experts whose special duty it is to make experiments constantly with different lubricants for different purposes, and from the results they obtain we prepare oils best adapted for each use. I claim that these experts know more about lubrication than it would be possible for engineers to learn, unless they devoted their entire time to the subject, which, of course, is impossible.

It is our desire to sell to the trade the very best oil obtainable, for many of our contracts are to supply enough oil to lubricate a certain factory, railroad system, or steamboat line, and the poorer the quality of oil the more oil must be supplied, and we find cheap oil is the most expensive. Therefore, I would suggest to the readers of Mr. Nye's article that, if they take up the matter of testing oils, they accept the opinions of experts as to what are the best oils for different requirements, for an oil that is good for one cylinder is surely good for a second cylinder, or an oil good for one journal bearing should be equally as well suited for a second journal. If the engineers will ask all the large oil companies what in their opinion are the best oils for certain purposes and what the tests for same are, and use these figures as standards, then the engineers can make their tests on other oils and accept none but those which come up to these requirements. The oil trade would be thrown into perfect chaos if each engineer should have his own ideas about the requirements of oils.

Again, Mr. Nye deals a pretty hard blow against the oil drummer, which, I think, is unjust, for my knowledge of these men is that they are a very respectable class of hard workers. J. W. M.

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### Knight Bachelor.

*Editor* MARINE ENGINEERING:

Referring to your article in the April issue on "Head-On Collision of the Steamer *Knight Bachelor*," would state that the collision happened several years ago, about four and a half days from Halifax, which port the ship made unaided in perfect safety. The ship was bound west, light in water ballast, to load cotton for Liverpool to Continental ports. In the collision the greater damage was done above her water line; and below, her plating and stem were buckled in such a manner as to form an excellent cofferdam to the pressure of the sea against the collision, the chain locker, and No. 1 bulkheads, which were not damaged to any great extent. The new frames, stem, etc., were bent by the builders, Messrs. Connell, of Glasgow, Scotland, and shipped to Halifax, where the work was completed. The bow had quite the appearance of the original, and spoke well of the workmanship and the small facilities at hand.

R. L. MUIR.

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## QUERIES AND ANSWERS.

Q. 153.—Will you please answer the following questions in your Queries and Answers column:

How will you determine the size, capacity, and I. H. P. of fan and its engine for the purpose of forced draft in boiler room and cabin ventilation? SUBSCRIBER IN JAPAN.

The subjects of ventilation and forced draft, although closely allied, are dealt with separately. Where mechanical draft is used it is necessary to know the details of the boilers and the amount of coal necessary to burn. In natural draft from 12 to 15 pounds of coal may be burned per square foot of grate surface, while under forced draft double this amount, or 20 to 35 pounds, may be burned per square foot of grate. Each pound of carbon requires about 12 of air for complete combustion, theoretically; in practice it is found that this figure rises to about 20 pounds. In practice a pound of coal is considered equivalent to a pound of carbon in heating value and in the air required. Let us assume a special case of four single-end, three-furnace Scotch boilers, the furnaces each having a grate surface of 23 1-3 square feet, or 280 square feet in all, and that it is necessary to burn 30 pounds of coal per square foot of grate. Then the pounds of air necessary to burn this coal will be:

$$20 \times 70 \times 30 = 4{,}200 \text{ per boiler;}$$
$$4{,}200 \times 4 = 16{,}800 \text{ for 4 boilers.}$$

If the air is supplied at 90 degrees temperature, 1 pound occupies 13.8 cubic feet, therefore 16,800 pounds at 90 degrees will be equivalent to 231,840, or about 230,000 cubic feet. This, then, is the air necessary for the fans to handle. At this rate of combustion, namely, 30 pounds per square foot of grate, an air pressure of about 2 1-2 inches at the fans will be necessary, and, on the authority of one of the fan makers, a 50-inch fan running at 800 revolutions per minute and requiring an engine of about 4 horse power will handle this air.

Regarding the second part of your question, it is generally considered that to change the air in the cabins six times an hour is sufficient. In some of the cabins it may be necessary to change oftener. The method of finding the capacity of fans for cabin ventilation, then, is, measure the space in each cabin in cubic feet, multiply it by the number of times the air is to be changed in that cabin, and add all such results for each cabin in which the ventilation system is to be fitted. This will give the cubic capacity of the fan. The pressure which the fan must maintain, whether an exhaust or forced-draft system, will depend on the length of ducts, the location of fan, etc.; but a pressure

of 1 inch is in most cases considered sufficient. To fully understand mechanical draft one must study some of the text books on this subject, but the above examples cited show the outline of the two problems.

Q. 154.—Will you please answer the following question in your magazine:

Captain H. contends that a steamer running with the tide will log more knots than she will stemming the tide; I contend she will not, but will log the same. His idea is that running with the tide the wheel gets a better hold on the water. Which is right? E. L.

A.—Your stand in the question is right. The speed of a vessel should be measured by its speed through the water, and not by speed from points on land. There is no such thing as a propeller getting hold of the water better when going with the tide. As an illustration, take a steamer traveling in the ocean; would Capt. H. believe that the speed of a ship in reference to the water would be greater when going with an ocean current than it would when going against one? His idea is a mistaken one, and theory and practice fail to prove it. In official trials government vessels are run over the course in each direction, and the mean of the two speeds taken. If there were any such fact as Capt. H. claims, this would long ago have been discovered by the officials, who go into tidal corrections very minutely.

Q. 156.—What can I do to stop the noise of the checks on a feed pump which is connected to the rocker shaft of low-pressure engine and has 1 1-2-inch plunger and 10-inch stroke? Pipe is 1 1-2 inches to boiler. There is a check valve next to pump and one next to boiler, and both make too much noise. Would larger pipe and checks help? I have tried an air pass from pump to hot well of 1-4-inch pipe, but it is not a remedy. Would sharpening plunger do any good? Will you please give me a remedy? R. D. T.

A.—Your trouble is undoubtedly due in some measure to the small size of pipe in comparison with the plunger. The hammering of a check valve depends to a large extent on the velocity of the water through the pipe. The greater the velocity the more violent the shock at starting and stopping, and the greater the noise. It would certainly help matters to put in a larger pipe and checks. You make no mention of an air chamber on the discharge side of the pump. Such a chamber of ample size has a great influence in reducing shock and noise, and in maintaining a nearly continuous discharge through the feed pipe. Between these two methods you should be able to improve matters satisfactorily.

### Bids for Warships.

Bids for the three new 16,000-ton battleships were awarded June 9 to the three lowest bidders, as follows:

The *Vermont* to the Fore River Ship and Engine Building Company, Quincy, Mass., for $4,165,000.

The *Minnesota* to the Newport News Shipbuilding Company, Newport News, Va., $4,110,000.

The *Kansas* to the New York Shipbuilding Company, Camden, N. J., $4,179,000.

Contract for building one of the two new gunboats was awarded to the Gas Engine and Power Company, Morris Heights, New York, and the department has readvertised for bids on the other vessel. It will be remembered that these gunboats will measure 174 feet on load water line and 35 feet extreme breadth, with a displacement of 1,085 tons; and their armament will consist of six 4-inch, four 6-pounders, and two 1-pounder rapid-fire guns, and two Colt automatic guns.

## PERSONALS.

Edwin B. Sadtler, former chief hull draftsman at the William R. Trigg Company, is now naval architect at the Harlan and Hollingsworth Company. Before going to Richmond Mr. Sadtler for many years was connected with the Wilmington shipyard.

Louis H. Kenney, formerly with the Fore River Ship and Engine Building Company, is now assistant draftsman in the office of naval inspector of machinery, William Cramp and Sons Ship and Engine Building Company.

Walter E. Joynes, formerly draftsman with the Newport News Shipbuilding and Dry-Dock Company, has accepted a position in the hull-drawing office of the Bath Iron Works.

E. S. Cooley, formerly with the Newport News Shipbuilding and Dry-Dock Company, and lately an instructor in Sibley College, has just accepted a position with the Buffalo Forge Company as inspecting engineer.

Alfred B. Canaga, superintendent of machinery for U. S. S. *Connecticut*, Navy Yard, New York, N. Y., is now in charge of the designing and drafting in the Bureau of Steam Engineering, Navy Department, Washington, D. C.

William J. Norton, who was formerly with the Manitowoc Dry-Dock Company, Manitowoc, Wis., as general draftsman, has taken a position in the hull-drafting department of the New York Shipbuilding Company.

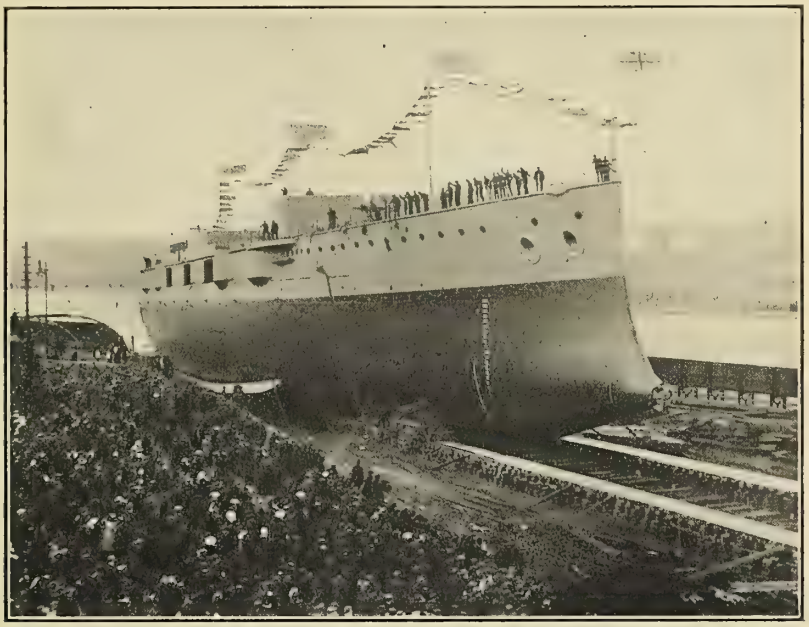
William Burlingham has accepted an appointment as chief engine designer with the B. F. Sturtevant Company, of Hyde Park, Mass., resigning a position in the United States Inspection Office with the William R. Trigg Company, of Richmond, Va. Mr. Burlingham has previously been associated with the Bath Iron Works, the General Electric Company, the Southwark Machine and Foundry Company, and the Newport News Shipbuilding and Dry-Dock Company.

## LAUNCHES.

**H. M. S. Battleship Commonwealth.**—The largest battleship afloat was launched on May 13 from the yards of the Fairfield Shipbuilding and Engineering Company, Ltd., Govan, Glasgow, Scotland. She has a draft of 26 feet 9 inches and the displacement will be 16,350 tons, while the launching weight was about 8,000 tons. The principal dimensions are: Length between perpendiculars, 425 feet; breadth, 78 feet; depth, 26 feet 9 inches. Krupp armor is used, and the side belt is about 22 feet deep, varying in thickness from 9 inches above the water line to 7 inches at the upper deck amidships, and 3 inches forward and 2 inches at the after end. The armament consists of four 12-inch guns mounted in pairs in barbettes forward and aft, and four 9.2-inch guns in barbettes, one at each corner of the central citadel. There are also ten 6-inch guns, fourteen 12-pounders, fourteen 3-pounders, two machine guns, and four torpedo tubes. The propelling machinery consists of two sets of four-cylinder, triple-expansion engines, the diameters of the cylinders being 33 1-2, 54 1-2, 63, and 63 inches, all built for a stroke of 4 feet. The low-pressure cylinders are fitted with double-ported slide valves, and the high- and intermediate-pressure

with piston valves; machinery to develop 18,000 I. H. P. and to give a speed of 18 1-2 knots. It is of special interest to note that the sixteen boilers, designed to work at 270 pounds pressure, are of the Babcock and Wilcox type. They are arranged in three water-tight compartments; the necessary air will be supplied by large steam-driven fans.

masts are of spruce 60 feet long. The total spread of sail will be 12,000 yards. A steam boiler is used for running all auxiliaries, including windlass, steam steering gear, pumps, electric lighting set, etc.



LAUNCH OF THE BRITISH BATTLESHIP COMMONWEALTH FROM THE FAIRFIELD YARD, SCOTLAND.
[Photograph copyrighted, 1903, by McPherson, Glasgow.]

**Steam Yacht Carmina.**—The steam yacht *Carmina* was launched successfully at Lawley's yard, Boston, Mass., on May 2, 1903. The *Carmina* is the largest steam yacht ever built at this yard. She is built of steel, the plating being on the raised-and-sunken system. The principal dimensions of the *Carmina* are: Length over all, 170 feet; on water line, 139 feet 9 inches; beam, 22 feet; draft, 10 feet 6 inches. There are two water-tube boilers of 250 pounds each, and she is propelled by a four-cylinder, triple-expansion engine of about 1,400 horse power driving a single screw. The *Carmina* was built under special survey of Lloyd's and is expected to be rated A 1.

*The Oil Tanker Capt. E. F. Drake.* *The Steamer Kiowa.* *Battleship Maine.*

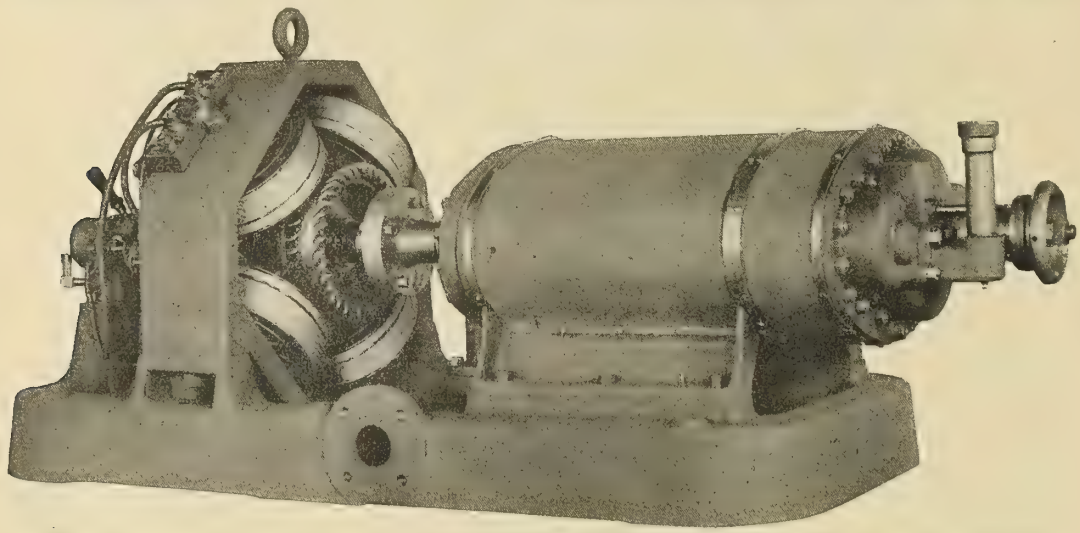
VIEWS OF NEW SHIPS AT CRAMPS' SHIPYARD.

**Five-Masted Schooner Dorothy Palmer.**—The finely-modeled five-masted wooden schooner the *Dorothy Palmer* was recently launched from the yard of George L. Weldt, Waldoboro, Me. She is 273 feet keel, 46 feet 6 inches beam, 26 feet 6 inches depth of hold, and the registered tonnage 3,000 gross tons. The ship is built of very heavy oak framing, hard pine planking, and the very strongest fastenings. The five lower masts are each 118 feet long and of Oregon pine, while the top-

### The Warren Rotary Engine.

It is odd to note that in the development of the steam engine the form first brought out by Hero, in Alexander, in the year 120 B.C., has for centuries been neglected, engineers and inventors confining their work to the reciprocating engine as brought out by James Watt. The latest developments of steam engineering are along the lines of the original Hero engine, a reciprocating or turbine type.

The turbine has established a place for itself in steam engineering, regardless of its inherent disadvantages of high speed. So many inventions of rotary engines have been brought out and failed that the term now often is considered equivalent to that of perpetual motion. The problems involved were most difficult of solution, and consisted in securing adequate and properly disposed ports, cylinder ratios and clearances, perfect balancing, and, above all, in securing steam-tight joints at a piston speed so high as to prohibit the use of any heretofore known means of packing.



ROTARY ENGINE, DIRECT-CONNECTED, 14-K. W. SET. DESIGNED FOR 80 POUNDS OF STEAM. COMPOUND, NON-CONDENSING.

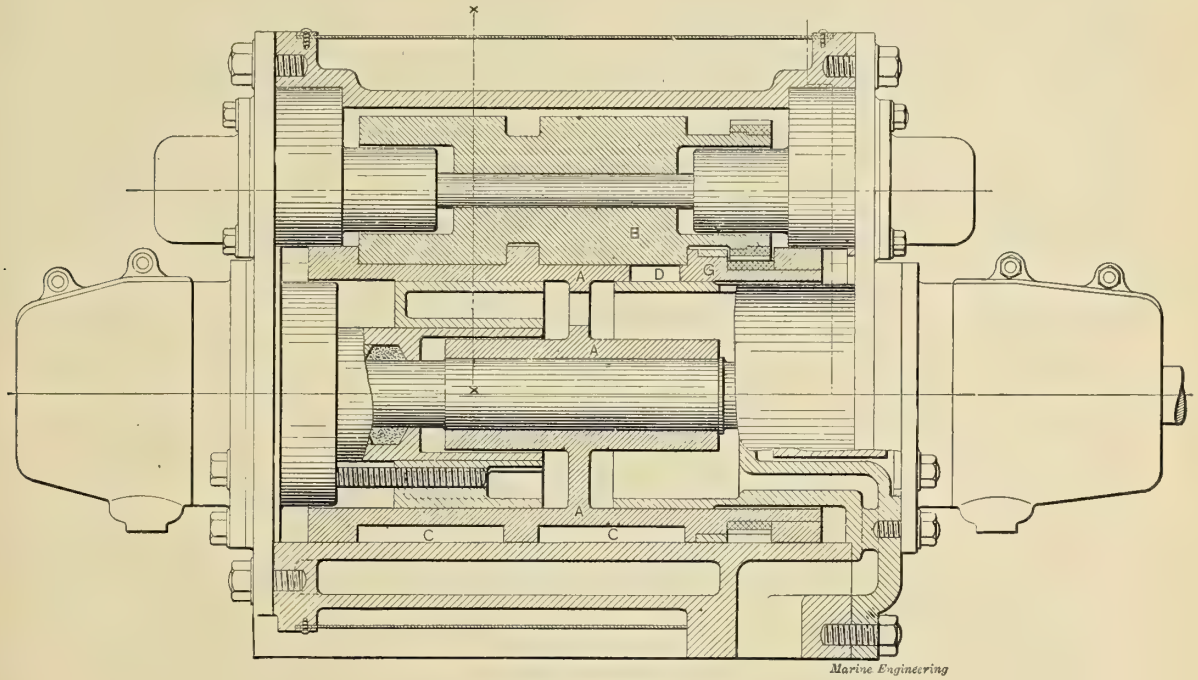
As the result of many years of study, experiment, and investigating the patents of rotary engines, it was evident to the designers of the Warren engine that the fundamental difficulty to be overcome was the question of tight joints at the desired piston speed of 3,000 feet per minute, which speed was considered most desirable and economical for this type of engine. This principle, so important for this class of engine, proved to be remarkably simple. Eliminating friction and securing perfect mechanical contact between two surfaces, without subjecting these surfaces to unnecessary and injurious pressure, in order to hold them together against the action of steam, is briefly what has been accomplished in this engine. In a word, perfect contact is maintained without appreciable pressure between the sliding surfaces. Therefore, as the elements that contribute to the production of mechanical friction are simply surface area multiplied by the pressure, if the pressure element be eliminated there cannot be any friction between the surfaces, regardless of their relative speed. Two highly-polished surfaces may be placed in intimate contact without the use of any measurable pressure, and such a contact will be as steam-tight as if the surfaces were forced together under heavy pressure.

Now, considering the accompanying drawings from the Rotary Engine Company of Philadelphia, we can follow the method of working out this principle. On this page is given a photograph of a direct-connected generating set, with rotary engine, and of about 14 K. W. capacity. The engine is a compound, designed for special service with steam only at 80 pounds, and is non-condensing, which, as stated by the builders, makes it abnormally large in proportion to generator.

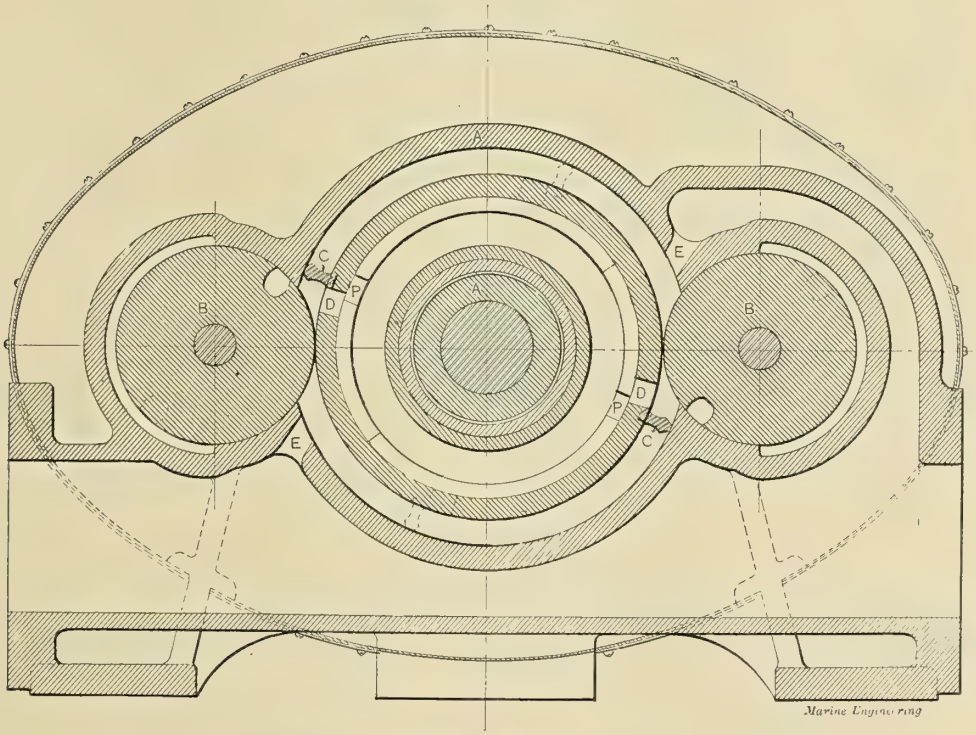
Figs. 1 and 2 show the longitudinal and transverse sections through the engine, which consist essentially of a concentric piston wheel, *A*, and shaft, mounted between two oppositely placed rotary abutments, *B, B*, said abutments being driven by the gear, as shown at the right in Fig. 3. The piston wheel *A* carries a broad flange at either end, between which, across the face of the drum of the wheel, the vanes or pistons, *C, C*, are mounted, the outer edge of the blade being turned off in line with peripheral surface of the flanges. The wheel *A* fits into the cast-iron casing, so that there is practically no clearance between the surface of wheel and casing. The heads of the casing fit into the ends of the driving wheel and form the ports *P*; thus the inside of the wheel is in close contact with the heads of the inner casing. The main bore of casing and wheel has a slight taper from end to end, and the wear is taken up at the thrust bearing, the thrust being due to the slightly different diameters of the two ends of the tapered wheel exposed to the steam pressure; thus the moving surfaces are maintained in pressureless contact. The wear of the surfaces is designed to equal the wear in the thrust bearing, so that the wheel will work gradually into the taper to make up for the wear of blades on the casing. The thrust is also adjustable, and thus an intimate contact is secured. This has been demonstrated from an engine of this kind run at speeds up to 5,000 feet per minute, when the contact surfaces were brought to a mirror-like polish. Thus, a nice mechanical balance is maintained in this ideal condition of contact without meeting with the extreme difficulties

encountered in balancing turbine wheels running at five to seven times the peripheral speed. It will likewise be noted that the lateral pressures upon the wheel and other than its own weight, which is taken care of by large, well-lubricated journals.

In the abutments *B*, *B* it will be seen that there are




Longitudinal Section




Cross Section at XX

FIGS. 1 AND 2.—LONGITUDINAL AND CROSS-SECTIONAL VIEWS OF THE WARREN ROTARY ENGINE.

shaft are perfectly balanced, since equal areas at diametrically opposite points are exposed to equal pressures. Thus the driving wheel is free from all strains tending to deflect it from its center and axis of rotation

grooves extending from end to end for admitting vanes *C*, *C*, and for ample clearance. The abutments are driven by a gearing giving a ratio of two to one, the single groove in the abutment being thus made to meet

successively each piston. The abutments are mounted on shafts having bearings formed in the counterbored end plates of the abutment chamber. Provision is made in these bearings for applying pressure to more than counterbalance the pressure of the steam tending to force abutments and piston wheel apart and to open up the joints. This pressure varies with the working steam pressure. It will be noted that the pitch diameter of the gear, Fig. 3, is slightly less than the outside diameter of the wheel; therefore there will be a sliding contact between abutment and wheel, which will cause the two rolling surfaces to wear each other away. This difference in speed amounts to about 600 feet per minute. Similarly, the seats formed by the bore of the abutments will be worn away at an exceedingly slow rate. As the wheel progresses slightly into its bore the abutment can follow it closely, as it is free within certain limits to follow the longitudinal movement of the wheel.

Now, referring to the operation of the engine, it may be stated that the steam cycle is essentially similar to that of a Corliss engine, except that the admission and cut-off are equally quick. Steam is admitted into the interior of the drum-shaped piston wheel, as shown in Fig. 3, and enters the working steam chambers through ports *D* and *D* in the drum of the wheel; the engine shown being of the type designated as duplex simple, that is, the single-expansion chamber is divided by an intermediate flange into two equal compartments, having pistons set 90 degrees apart in order to insure uniform turning moment. The two drum valves, *P*, *P*, are mounted upon inwardly-projecting hubs cast as an extension of the casing heads, and, in the simple form of engine shown, are made fast to these hubs, giving a fixed cut-off; governing, when required, being accomplished by throttling. In the larger sizes and in compounds the drum valves are arranged to be shifted upon the hubs, and are controlled by a special governor, which regulates the speed of the engine by varying the point of cut-off in the high-pressure cylinder.

It is not necessary to maintain a perfectly tight joint between the drum valve and the interior surface of the piston wheel, as any leakage past the valve merely results in raising the expansion line in the working chamber and adding a slight superheat during the latter stages of expansion. The valve is, therefore, fitted simply with a close "running fit." The lowering of the main wheel through wear cannot proceed far before the increase of mean pressure in the lower steam chamber will become sufficient, acting upon the full projected area of the wheel drum, to balance or support the weight of the wheel and shaft, and it is obvious that after this point is reached there can be no further downward wear of the main journals, and, consequently, no further increase of leakage past the cut-off valve. When the port *D* has passed the opening of the valve, steam is cut off and expansion takes place until the blade reaches the exhaust port *E*, when the steam exhausts into the passages shown. No tests of steam consumption are as yet given out. It is claimed that a saving of 10 per cent. may be secured over reciprocating engines because of the absence of frictional resistance. Having in view the continuous turning effort, absence of reciprocating parts, the features of the cut-off, expansion, and exhaust, there ought to be realized high economy in large sizes.

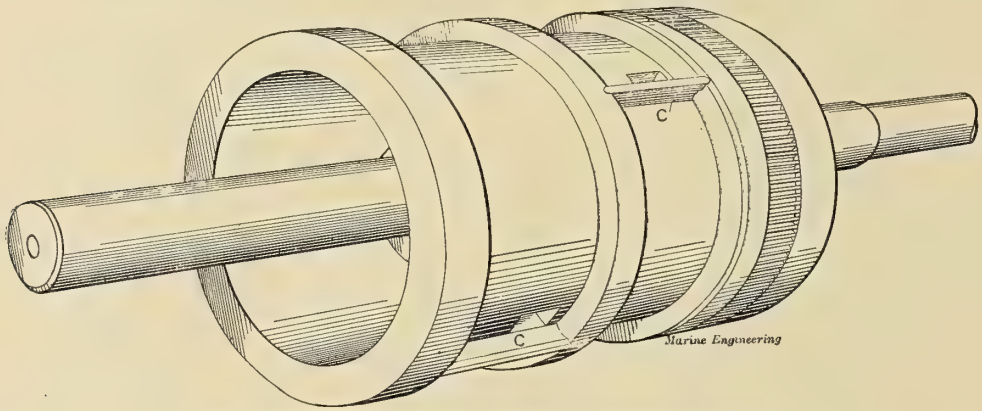



FIG. 3.—PERSPECTIVE VIEW OF THE RUNNER, OR ROTATING MEMBER.

As the Warren engine is readily reversible, possessing the desirable qualities of the steam turbine while rotating at lower speed, it ought to be peculiarly adapted for marine propulsion. The other features which are claimed to adapt it to general steam-engine service are that it has all the desirable features of the reciprocating engine, has practically unlimited range of speed with uniform angular velocity, is free from vibration, is of greatly reduced bulk and weight, and is sold for less than either reciprocating engine or turbine.

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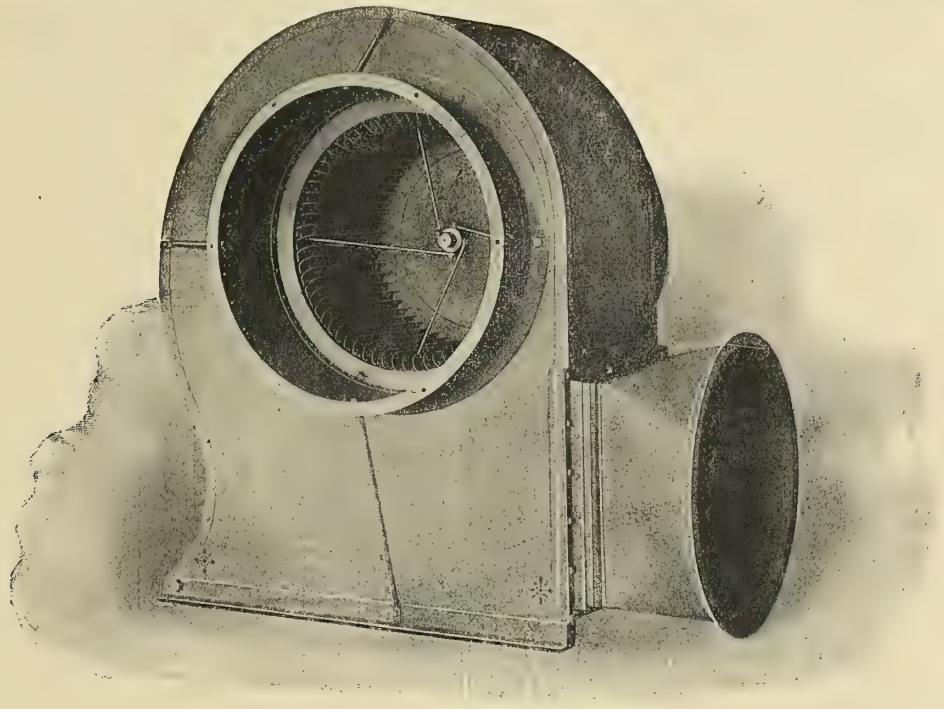
**Revoke Engineer's License.**—The local board of the United States Steamboat Inspectors of the port of New York rendered a decision recently revoking the license of Joseph W. Cornell, a tugboat engineer, who, previous to the recent strike, was employed by the Newtown Creek Towing Company Charges against him were preferred about two weeks ago by the company formerly employing him. It was alleged that Cornell quitted his employment without giving sufficient reasons, and thereby violated the oath under which he held his license. Charges were brought by the Newtown Creek Towing Company and by the White Star Towing Company against other engineers in their employ. The action of the local board in this case will stand unless an appeal is taken to the Supervising Inspector, as under law an engineer has thirty days in which to appeal.

### The Sirocco Fan.

A most interesting exhibit of a new type of fan, called the Sirocco Centrifugal Fan, is now to be seen in New York city. The fan is built differently from other centrifugal fans, in that the blades are long, narrow, and curved forward in the direction of rotation and mounted parallel to the shaft. The length of the blades is three-fifths of the diameter, and it has been found that over the several sizes of fans sixty-four blades give the best results. The blades are riveted to an iron ring at the back, which is attached to a cast-iron conical hub, and the front ends of the blades are riveted to an iron ring adjustable by guy rods, as shown in the illustration.



INTAKE VIEW SHOWING RUNNER OF SIROCCO FAN.

The blades measure radially one-sixteenth the diameter of the fan and measure lengthwise three-fifths the diameter. The inlet of the fan is through the area inscribed by the forward ring, and the discharge is through a casing, as is usual in centrifugal fans. The inlet and discharge areas are practically the same.

With the fan thus briefly described, some very interesting experiments were performed to compare it with the ordinary type of centrifugal fan. It is claimed by the makers of the Sirocco that the use of this fan shows an entirely new departure from the former science and principles of centrifugal fans, and that if the old rules for volumetric efficiency were applied to this type the result would work out to something like 400 per cent.

The exhibit consists of several Sirocco fans, each mounted to illustrate a different feature. One is of a 25-inch motor-driven fan running at 550 revolutions, or with a peripheral speed of 3,600 feet per minute, discharging air at a velocity, according to measurements, of 6,000 feet per minute, and representing a discharge of 16,000 cubic feet at zero pressure. Next was a fan of 17 1-2 inches in diameter, with hand gearing, discharging into a box with adjustable openings and fitted with pressure gage. The fact that the power required to drive a fan increases as the area of the discharge is increased, up to a certain area, is one that is seldom realized. The observer of this exhibit need but turn the hand gear of this fan and feel the increased load as the discharge area is opened, to fully realize that the load increases with the area of discharge.

The most interesting exhibit in the room is that called the "tug-of-war" contest, which consists of two fans, one a 12 1-2-inch Sirocco and the other a 24 3-4-inch centrifugal blade fan of the ordinary type. The discharge from each of these is led directly into a sheet-metal air-tight box, one discharge entering the box at one end and the second discharge at the other end; the box is divided by a division wall, with a door in same. Both fans are belted from a line shaft, the pulley being of such diameter that the Sirocco fan makes higher number of revolutions but a slightly decreased peripheral speed than the ordinary fan. The area of discharge of each fan is the same, and, according to the accepted rules, the pressure against which air is discharged should be practically the same, as the peripheral speed of the blades is the same. It is claimed, however, that the air leaves the Sirocco blades at a greatly accelerated speed, and that it actually exceeds the peripheral speed by about 70 per cent., as shown in the test of the 25-inch fan, above mentioned. This increase is claimed to be due to the curvature of the blades and to the fact that there are no eddies or back currents of the air in passing through the blades.

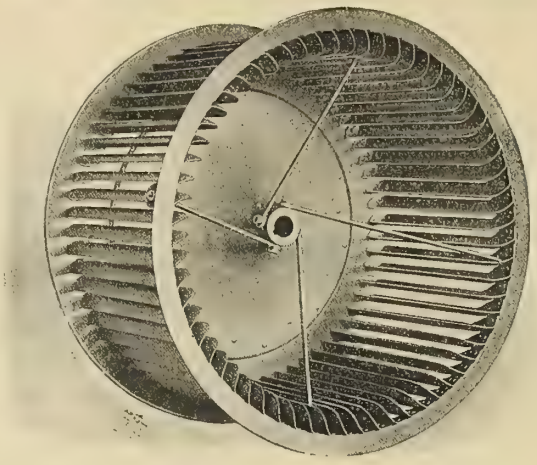
A test of these two fans was run by our representative, and the results are given in the appended table. When

the two fans were running at a peripheral speed of about 4,000 feet per minute for the Sirocco and 4,200 of the ordinary fan, discharging into the closed box with the door in division wall open, a most remarkable result occurred. A little red flag placed in the opening showed clearly that the draft was going from the Sirocco to the other fan, and at no uncertain speed. This fact was further demonstrated by the draft of air at the suction of the Sirocco, which was most decidedly inward, and at the suction of the other fan, which was to the same extent outward. A large door in the top of the box was quickly opened and closed, and every time that it was closed the same direction of the draft was observed.

The second part of this test consisted in closing the division door and measuring the discharge through the door in the top of the box. Each discharge was of exactly the same area, viz.: 8 5-8 by 12 3-8 inches. The air pressure in the Sirocco box was 1 5-8 inches and in the other box 1 inch. The third test consisted in closing the upper door, with the division door also closed. The pressure in the Sirocco box was then 2 5-8 inches, while in the other box it was 1 3-8 inches.

The volt and ammeter readings of the dynamo which was driving the line shaft were taken under each of the conditions and will be found in the record of the test.

There was no way of measuring exactly the power required to drive each fan, but comparative values were obtained, first, by taking the belt off the Sirocco fan and running the ordinary fan, and then by replacing the Sirocco belt and removing the other belt. The results will be found under the table of the fourth test. It must be remembered in this connection that the volumetric discharge of the Sirocco, as recorded, was much greater than that of the other fan. It is claimed by the makers that the mechanical efficiency of the Sirocco is about 10 per cent. greater than that of other fans, and this statement has been carefully checked by test No. 5.



THE RUNNER.

COMPARATIVE TESTS OF SIROCCO AND ORDINARY-TYPE FAN.

| Tests. | Rev. per Min. | | Peripheral Speed. Ft. per Min | | Air Pressure. Inches. | | Amperes. | | Volts. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sirocco. | Ordinary. | Sirocco. | Ordinary. | Sirocco. | Ordinary. | Sirocco. | Ordinary. | Sirocco. | Ordinary. |
| No. 1. Box closed, division door open..... (Vel. air into Sirocco over area of 154 sq. ins. = 3 000 ft.) | 1,250 | 690 | 4,110 | 4,470 | 2 | 1 | 20 | | 107 | |
| No. 2. Box open, division door closed ..... | 1,235 | 680 | 4,050 | 4,400 | 1⅝ | 1 | 23½ | | 107 | |
| No. 3. Box closed, division door closed..... | 1,275 | 705 | 4,180 | 4,565 | 2⅝ | 1⅜ | 18¼ | | 108 | |
| No. 4. Each fan run separately. Box open, door closed..... | 1,285 | 720 | 4,220 | 4,660 | 1⅝ | 1⅛ | 21½ | 15 | 108 | 108½ |
| Zero load of shaft, etc.. ..... | .. | .. | .. | .. | .. | .. | 8 | | 109 | |

| Test No. 5. | Rev. per Min. | Peripheral Speed. Ft. per Min. | Air Pressure. Inches. | Vel. Air at Discharge. | Cu. Ft. Air per Min. | Amperes | Volts. | Watts. |
|---|---|---|---|---|---|---|---|---|
| Sirocco..... | 1,000 | 3,280 | 1 | 4,000 | 35,500 | 16 | 86 | 1,375 |
| " zero load..... .... | .. | .. | .. | .. | .. | 7 | 98 | 686 |
| " power absorbed by fan ..... | .. | .. | .. | .. | .. | .. | .. | 689 |
| Ordinary..... | 710 | 4,600 | 1 | 3,960 | 35,200 | 15 | 111 | 1,665 |
| " zero load ..... .. ... | .. | .. | .. | .. | .. | 8 | 112 | 896 |
| " power absorbed .... ..... | .. | .. | .. | .. | .. | .. | .. | 769 |

The same instruments, voltmeter, ammeter, and anemometer, were used for all tests. They were not calibrated, as *comparative* results alone were desired.

To demonstrate that a fluid in passing through a Sirocco fan is given a higher speed than the tips of the blades, the fourth exhibit was most interesting. As it is almost impossible to measure absolutely the velocity of air, this point is demonstrated by using a 6-inch Sirocco fan as a water pump. The suction of the fan is connected with a large tank and the discharge takes place

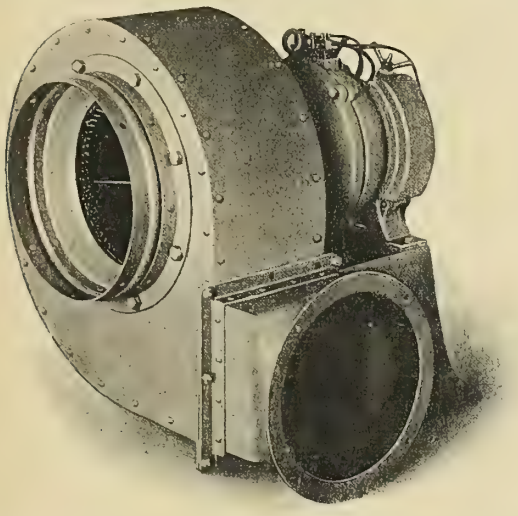
at a level just 4 feet above the suction level when the pump is running. A 4-inch discharge pipe is used. The runner is geared to a hand wheel at the ratio of 8.3 to 1;

TABLE OF DIMENSIONS.

| | Sirocco. | Ordinary Type. |
|---|---|---|
| Runner, diam. over all ins. | 12½ | 24¾ |
| " length of blade " | 7¾ | 7¾ |
| Casing, width, ins. | 11 | 12 |
| " " over all, ins. | 15 | 16¼ |
| " length " " " | 25 | 37½ |
| " height above floor, ins. | 31¼ | 42 |
| Inlet, area, sq. ins. | 95* | 154 |
| Discharge from box, sq ins. | 106.6 8⅝x12⅜ | 106.6 |

*At point where velocity of air for Test No. 1 was taken the area of inlet is 154 sq. ins.

on turning this hand wheel 60 revolutions per minute a solid column of water was discharged through the pipe at the above-stated level. At this number of revolutions the peripheral speed of the blades is evidently



SMALL MOTOR-DRIVEN FAN. CASING CAN BE ADJUSTED TO DISCHARGE IN ANY DIRECTION.

$60 \times 8.3 \times 1.57 \div 60 = 13$ feet per second, while by formula the theoretical velocity required to raise water this height would be 16 feet and the residual velocity of discharge being about 4 feet, with a frictional resistance in the pipe of about 1 foot per second. Thus this pump has to work against an equivalent head of 21 feet, while the velocity of the blades is but 13 feet.

Still another test (No. 5) was made to ascertain the comparative amounts of power required to drive the two competitive fans while discharging the same output against the same pressures. Each fan was driven singly by the motor, the speed of the Sirocco being regulated down by means of the rheostat on the dynamo till the pressure in the box equaled that of the other fan. This was checked by anemometer readings of the discharge, the discharge from box of each fan being of the same area.

Another interesting feature of the exhibit is a type of propeller fan, which is put together and mounted in a very strong but simple manner.

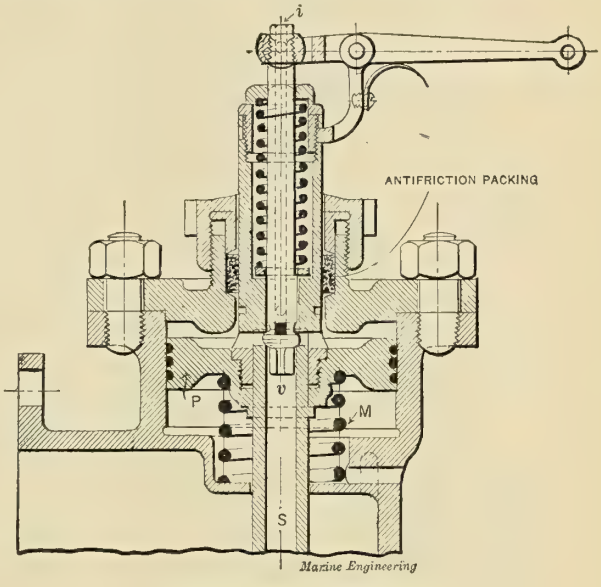
These fans may be seen in operation and the above experiments observed at the office of Davidson and Company, Ltd., 22 Thames street, New York city.

## ENGINEERING SPECIALTIES.

### New Form of Safety Valve.

The description of the Tippett safety valve which appeared in the November, 1902, MARINE ENGINEERING, has elicited from Mr. Dagnino Attilio, Sampierdareno, Genoa, Italy, a description of a similar safety valve invented and patented by himself, the operating mechanism of which is herewith illustrated.

The main valve is mounted on a spindle, *S*, and is controlled by the small valve *v*. When the steam pressure reaches the point at which the valve is to blow off it raises the controlling valve *v*, which is otherwise held in place by the light spring above it or by weights. The spring can be adjusted to any pressure. Steam escapes through the valve *v* behind the large piston *P*,




SIMPLE FORM OF SAFETY VALVE.

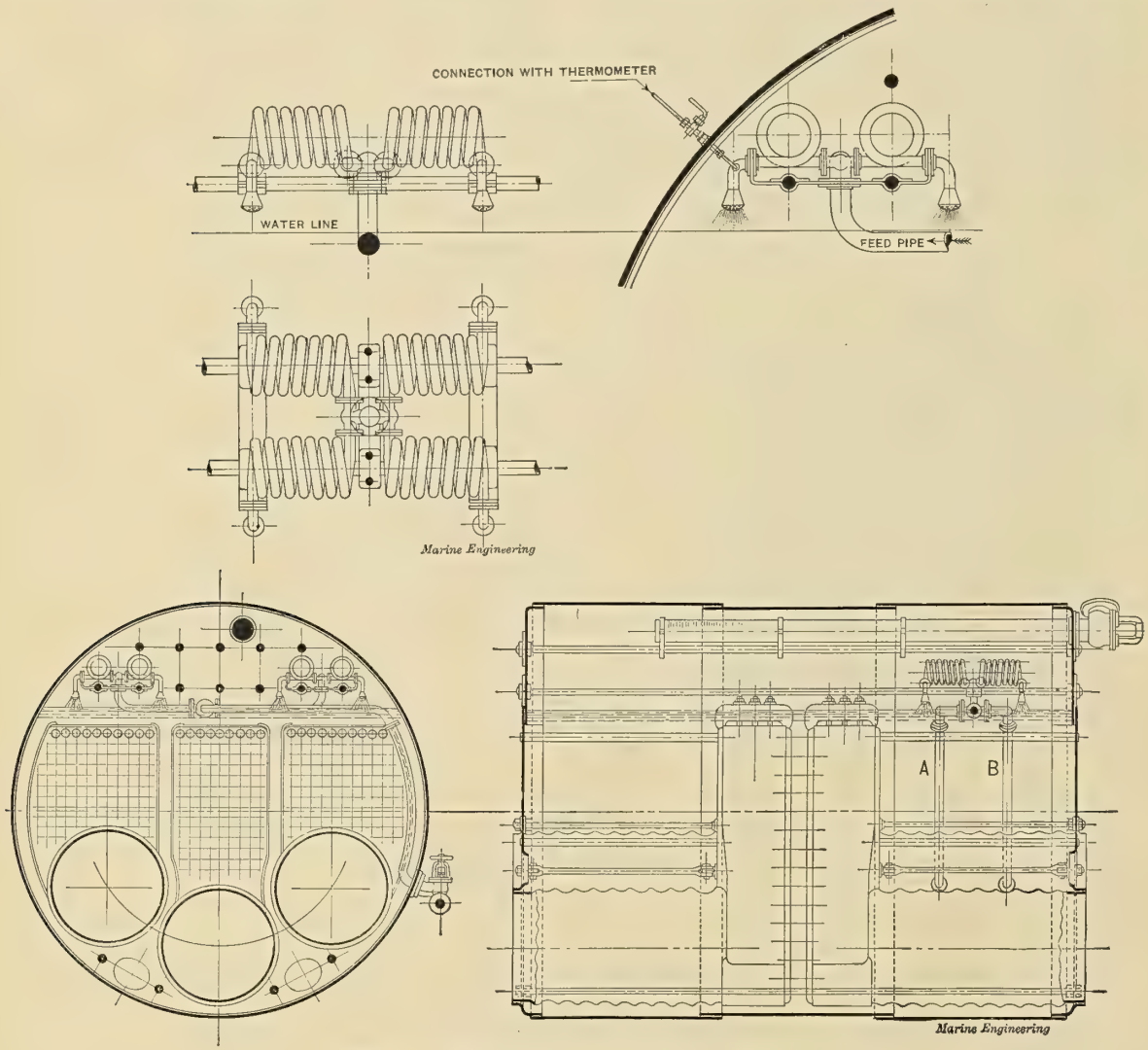
and forces this piston down against the spring *M*, opening the main valve, which is, as stated, at the other end of the spindle *S*. The main valve opens with promptness, but slowly until it has reached its full opening. When the boiler pressure decreases, the controlling valve *v* is closed, and the steam escaping through the ports, *i*, in the hollow rod, reduces the pressure behind the piston, *P*, and the valve closes. The points claimed for this valve are its simple construction and operation and that it is closed when there is no pressure in the boiler.

### Feed-Water Heater.

It is a most essential thing that the feed water shall enter the boiler as warm as possible, both to effect economy of fuel and avoid wear of the boiler. In the consumption of fuel the average ship fitted with a triple-expansion engine uses 1.80 to 2 pounds of coal per indicated horse power per hour, but there are triple-expansion engines in use where the consumption of fuel is reduced to as low as 1.5 pounds per horse power per hour, and even about 1 pound in rare cases. This gain in efficiency is accomplished by having well-designed engines and boilers, and by the heating of the air furnished to the furnaces for combustion, the stoppage of

all steam leaks in boilers, pipes, engines, and stuffing boxes, etc.; but perhaps the most important item is the heating of the feed water. It has been estimated, for instance, that on a ship where the feed water is pumped into the boilers at a temperature of, say, 100 degrees, if a heater is fitted which, without entailing the use of heat otherwise useful, raises the temperature of the feed water to 212 degrees, a net saving of nearly 10 per cent. in the fuel will be accomplished.

by means of the tube *AB* with the feed-water valves, which are placed outside of the boiler. The feed water, passing through this instrument, becomes heated to a temperature which in no case is less than 60 degrees below the steam boiler temperature; hence, for a boiler working at steam pressure of 150 pounds, with the temperature of steam being 365 degrees, we get a feed-water temperature of 340 to 350 degrees. This apparatus does not occupy space in the engine room, requires




A TYPE OF FEED-WATER HEATER FOR USE INSIDE OF BOILERS.

Many attempts have been made to heat the feed water with exhaust steam, hot gases in the uptake, etc., but no great measure of success has attended the efforts of those who have paid most attention to this, for the apparatus employed has generally been insufficient, and, while costly and cumbersome, its durability has been short. The heater illustrated herewith is a very practical and a much cheaper instrument for the purpose, and its utility has been demonstrated by many applications on board modern and old ships of the Italian merchant marine. It has been designed and patented by Mr. Pautrie, of Genoa, and consists of four yellow copper coils, placed as is seen on the accompanying figure, in the steam space of the boiler and connected

but occasional cleaning, and it is always working, whether the feed water is injected by the main or auxiliary pumps.

Thus the feed water being discharged at the water level does not cause cold currents in the mass of water; the air that is always present in the water, being heated to a high temperature, goes off the boiler as gas, together with the steam; and the impurities and greases usually accompanying feed water do not come in contact with the heating surface of the boiler, but remain, instead, on the water level, and, therefore, being easily removable, prevent the acids produced by the fatty matter from causing injury to the iron surfaces. Further, feeding water at such high temperature, evaporation

proceeds with greater rapidity, and constant pressure is maintained, while economy in fuel is good. The boilers of the new Argentine Republic battleship are fitted with Pautrie's heater.

In the month of July, last year, the bark *Ella Moore,* laden with railroad ties, ran ashore near Canso, Nova Scotia, about 200 miles from Halifax. The photograph shows how the vessel lay, almost completely

THE ELLA MOORE HARD AND FAST ON THE NOVA SCOTIA SHORE.

### Wreck of the Ella Moore.

The shores of Nova Scotia are, during the summer months, veiled in heavy fog for more than half the time, and the rock-bound coast is strewn with wrecks. The force with which steam vessels here go ashore, and the nature of the coast, have prevented salving of but a small percentage of them.

land-locked, but fortunately she did not strike hard and was eventually saved. The illustration is remarkable for showing, first, that a vessel could float after striking head-on on such rocks as are in evidence; and, second, the depth of the water directly off the headlands of the coast.

## TECHNICAL PUBLICATIONS.

**The American Steel Worker.** By E. R. Markham. Size 5 1-2 by 8 inches. Pp. 343, with 160 cuts in the text. New York: The Derry-Collard Company. Price $2.50

This book is prepared by one who has had twenty-five years' experience in the selection, annealing, working, hardening, and tempering of various kinds and grades of steel. It is written from the practical rather than from the theoretical or scientific standpoint, and is intended primarily for the every-day use of the practical steel worker. To this end the author discusses the characteristics of the various grades of steel, and shows the relation of each to the composition and to the various operations to which the tool may have been subjected in the process of making. Useful hints are given regarding the selection of steels for various purposes, and the best modes of operation are given in detail for the various tools and special purposes to which tool steel may be applied. Beginning with the initial selection of a suitable grade of steel, the author discusses the best modes of heating, forging, annealing, tempering, and hardening steel tools, according to the purpose in view. Naturally the subject of tempering and hardening comes in for special notice, and illustrations are given of a great variety of furnaces, baths, vats, and other appliances for use in connection with such operations. Case-hardening by various processes is also fully discussed, and illustrated with cuts of the appliances and methods available for particular purposes.

As a whole, the book is clearly written, and gives to the point the information most likely to be needed by the practical worker in steel. One might have wished, perhaps, for a somewhat fuller treatment of modern special air-hardening steels for rapid work, as lathe and planer tools, etc. As the author properly notes, however, it is difficult to give general instructions for working such steels, because the composition and best mode of treatment of the different makes vary so widely that the treatment suitable in one case would be quite unsuitable in another. A few general hints are, however, given, which, with the special instructions accompanying such steels, should insure the best results of which the material is capable.

Modern competition in all classes of manufacturing work calls for the very closest attention to economy of production, and it is here that the importance of the steel tool enters the problem. The difference between a steel tool which will hold its edge and one which will not, between a tool which is producing the maximum output and one which is not, may make just the difference between success and failure or between profit and loss. An intelligent study of the directions and principles given in this book should go far toward insuring a possibility of the maximum output, so far, at least, as such may depend on the efficiency of the steel-cutting tools which may be employed. The book is cordially recommended to all steel workers, and to all interested in the treatment of tool steel for maximum productive capacity.

**Bemastung und Takelung der Schiffe** (Masting and Rigging of Ships). By F. L. Middendorf. Size 7 1-2 by 10 1-2 inches. Pp. 400, with 172 figures in the text and folding plates. Berlin: Julius Springer, 1903. Price 30 marks.

This work by the director of the German Lloyd was undertaken with the purpose of bringing down to date, in the literature of marine construction, many recent improvements and advances in this particular part of the field, a part which has suffered some neglect since the passing of the sailing ship as the embodiment of the best art and skill of the naval architect and shipbuilder. In spite of the relatively decreased importance of the sailing ship, however, many important improvements have been made during the past few years, naturally rendered possible by the advances along all constructive lines. These improvements, as constituting the best practice of the day, it is the author's purpose to present in concrete and convenient form. Again, the author notes in the modern four- and five-masted ships and in the many-masted schooners—five, six, and seven—new problems which justify careful consideration in comparison with older and more standard practice.

The general subject is treated under three main heads. Under the first the author discusses the theoretical foundation upon which the practical art is based, and to which he will have occasion to refer. Here will be found an excellent brief discussion of the general topics of displacement, statical and dynamical stability, metacentric height, inclining experiment, center of gravity of ship and of cargo, freeboard, etc., etc. Under the second main head the author discusses the subject proper, masting and rigging. The subject is treated first in general terms, and then examples are given, with plans and computations in detail, drawn from practically all commercial types of sailing craft, and including three-, four-, and five-masted ships and barks, brigs, brigantines, and schooners from seven masts down, and with various combinations of square and fore-and-aft sails, yachts, fishing craft, etc. In a second section the masting and rigging of steamships is discussed with like detail and thoroughness. For each case a sail and rigging plan is shown on a folding plate, and all computations are given with full detail, together with body plan of the ship and diagram of the various geometrical quantities. Under the third main head the author discusses the various details connected with his subject, and illustrates the best approved forms of the various parts. This part of the work is of exceptional interest and value, and contains many tables and diagrams which would be most useful in connection with arranging the details of such work.

As a whole, the work forms a most notable addition to the literature of this subject. The treatment is comprehensive and full, replete with valuable information in both tabular and graphical forms, and would most certainly prove an invaluable aid to those having to deal with such problems in German practice, while to all it will be found a rich mine of information relating to this part of the marine constructor's field.

**The Proportions and Movement of Slide Valves.** By W. D. Wansbrough. Size 5 by 7 1-2 inches. Pp. 160, with 50 diagrams in the text. Manchester: The Technical Publishing Company. Price 4 shillings 6 pence.

This book is a reprint of a series of articles originally published in the *Mechanical World*. Inconvenient for general reference or for the study of a particular case,

they are here republished in a more acceptable and convenient form. The subject matter consists of fifty cases of slide-valve analysis or design, covering all manner of problems relating to slide valves, either single or double, with or without an expansion plate, and with cut-off blocks of the "Meyer" type. For the solution of the first thirteen cases, constituting various forms of the problems of design for plain slide valves, a series of special constructions is given, but without attempt to relate them all to the few necessary principles involved. For most of the remaining cases, involving design and analysis, the Zeuner diagram is employed, with some modifications as found useful by the author.

The book, in effect, consists of a series of constructions, stated for the most part without reasoning or attempt at proof, and simply leading the designer along, step by step, to the end of his route, but without stimulating such study as should tend to make him independent of such aids. For the busy designer who may not wish for the reason why, and who is only desirous of reaching a given end, such a book may be of value. For the true student its chief value would be as a series of constructive exercises for which he might endeavor to work out the proofs.

From the author's point of view, however, the work is carefully and thoroughly done, and in the drawing office the book would certainly find use. The chief criticism, mechanically, is with the cuts. The same blocks have evidently been used as for the original publication, and many of them are much blurred, while in some of the more complicated the scale is so small as to make reference to them hard for the eyes. The book is printed and bound in the usual style of the publishers, and, for many purposes, should prove a useful contribution to the literature of slide-valve problems.

**Beeson's Marine Directory, 1903.** Harvey C. Beeson, 370 Dearborn street, Chicago, Ill. One volume, 260 pp. 6 1-2 by 9 1-2 inches. Price $5.

The sixteenth annual edition of Beeson's Marine Directory of the Northwest Lakes for 1903 has just been published. This book is a development of the directory published several years ago by the Lake Marine Service of Detroit under the Secretary of the Treasury. From its inception the Beeson's Directory has grown annually, and its contents embrace lists of American steam and sail vessels of the Lakes, giving their rig, dimensions, year and place of building, names of owners, insurance rating, etc.; lists of engines and boilers, with dimensions; list of Canadian vessels, both steam and sail; lists of vessel owners and shipmasters, besides articles of special value written for the work by well-known writers. The volume is well illustrated with views of vessels of all classes. It is printed on heavy paper and bound in red cloth.

**New System of Awarding Machine-Shop Labor.** By H. L. Gantt. A 12-page reprint from Cassier's Magazine, 3 West Twenty-ninth street, New York, N. Y. Price 10 cents.

The above-mentioned reprint deals with the various methods of encouraging increased production among workmen, especially in engineering works. No system has ever produced such satisfactory results as some form of a bonus system, but a bonus system without some method of imparting the necessary information both to the employer and the employee is not likely to prove workable. This pamphlet deals not only with the system, but with the method of accomplishing what the system aims to accomplish—increased production and satisfied workmen.

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**Steamer S. V. Luckenbach.**—The oil-tank steamer *S V. Luckenbach* has been given up as lost. She left Sabine Pass March 21 for Philadelphia with a load of about a million gallons of oil assigned to the Sun Oil Company. She has not been reported since, and not a word has been heard of her captain or crew of 26 men.

**Alco-Motor.**—The Hamburg-American Line has been experimenting with a motor using alcohol as a source of power. The style of engine is like that of petroleum and benzine motors. It works after the 4-stroke system, and in such manner that at the first stroke alcohol and air mixed are drawn in, at the second stroke these are compressed, at the third stroke burnt through electrical ignition, and exhausted as burnt gas with the fourth stroke; consumption of 90 per cent. alcohol at about 0.6 kg. per hour and brake horse power.

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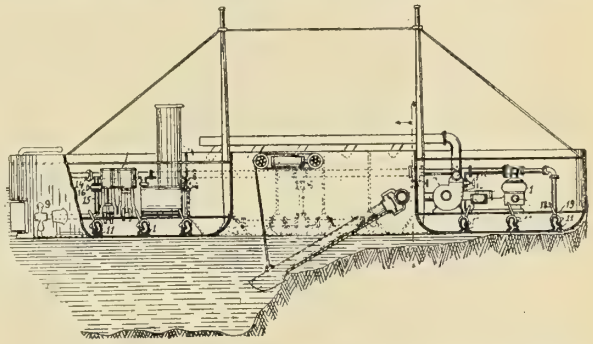
## SELECTED MARINE PATENTS.

724,488. PROPELLER. RICHARD MURR, SEATTLE, WASH. Two claims.

724,486. BOAT PROPELLER. JOHN H. MILLIGAN, BALTIMORE, MD.

*Claim.*—1. In a device of the class described, the combination with a propeller shaft of a hinged frame movable either to an upright or a horizontal position, gearing carried by the hinged frame for rotating the propeller shaft, a brace composed of upper and lower sections hinged together in a right line, the upper section being also hinged to the said frame and being arranged longitudinally of the lower section or in an approximately vertical position to form a support for the lower section, and a seat mounted on the brace. Two claims.

727,059. APPARATUS FOR RELIEVING GROUNDED VESSELS. GLEN E. BALCH, NEW YORK, N. Y.



*Claim.*—1. The combination with a vessel of a dredging apparatus, means for operating the dredging apparatus, pockets carried by the vessel for receiving the dredged material, a system of downwardly-opening jet nozzles at fixed points along the bottom of the vessel, and means for supplying the nozzles.

2. The combination with a vessel of a dredging apparatus, means for operating the dredging apparatus, pockets carried by the vessel for receiving the dredged material, a system of a downwardly-opening jet nozzles at fixed points along the bottom of the vessel, and a pump for supplying the nozzles. Seven claims.

724,935. PROPELLER. GEORGE QUICK, BOURNEMOUTH, ENGLAND.

*Claim.*—1. A screw propeller, the propelling surface of the blades of which from the hub outward toward the periphery is in the form of a concave curve, the said curved surface receding from the hub outward in the direction opposite to that in

which the propeller turns to drive the ship ahead, and the angle of the said recession of the propelling surface diminishing from the hub outward to the end of the blade. Two claims.

726,947. COMBINED VENTILATING AND OBSERVING TUBE FOR SUBMARINE BOATS. SIMON LAKE, BRIDGEPORT, CONN.

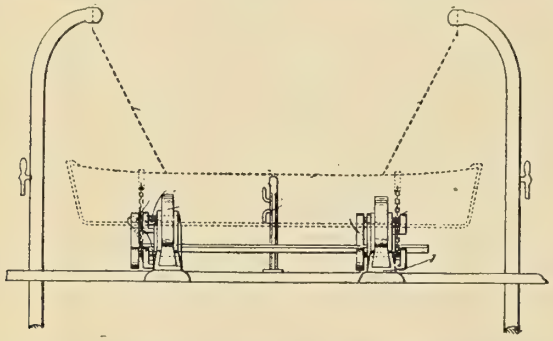
*Claim.*—1. The combination with a submarine boat of a combined ventilating and observing tube passing through the wall of said boat and having its end portions normally in communication, respectively, with the interior and exterior of said boat, and provided also in its upper or outer end portion with a reflector or reflecting surface adapted to receive and reflect downwardly or inwardly through said tube into the boat an image of an external object. Seven claims.

727,169. COUNTER-GRAVITY SCREW PROPELLER. CAREY A. MANKER, PEARL, ILL. Four claims.

727,175. SEA ANCHOR. THOMAS S. MILLER, SOUTH ORANGE, N. J.

*Claim.*—1. A sea anchor consisting of fixed and collapsible parts and mechanism whereby an increased resistance causes the collapsible part to collapse. Fifteen claims.

727,232. STOWING AND LOWERING OR RAISING BOATS. FRANCIS H. WADSWORTH, HELENSBURGH, SCOTLAND.



*Claim.*—1. Apparatus for lowering boats on shipboard, comprising inclined launching ways, and chocks in two parts mounted in said ways, both parts of the chock being adapted to slide together in said ways outboard, and means for securing the chocks in the launching ways. Eleven claims.

727,719. MAST HOOP. ROBERT W. VAIL, NEW YORK, N. Y.

*Claim.*—1. A mast hoop made up of two approximately semicircular sections of sheet metal concavo-convex in cross section, pivoted at their rear ends and terminating toward their front ends in cup-shaped members the convexities of which approach each other, and provided with means for securing such front ends together. Four claims.

727,774. SYSTEM OF COALING SHIPS AT SEA. ALEXANDER K. FINLAY, NEW ORLEANS, LA.

*Claim.*—1. In an apparatus for coaling ships at sea the combination with the collier and the vessel to be coaled of a tow line connecting the two, outriggers from the two vessels, one or more hauling lines connecting said outriggers, and one or more boats on each hauling line adapted to carry coal.

2. In an apparatus for coaling ships at sea the combination with a collier and a vessel to be coaled, a tow line connecting the two, outriggers projecting from each vessel, hauling lines connecting said outriggers, and boats completely housed over and adapted to carry coal, connected to said hauling lines. Two claims.

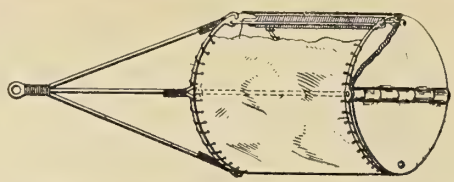
727,827. MARINE VESSEL. JOHN McMILLAN, BROOKLYN, N. Y. Four claims.

728,014. SUBMARINE CONSTRUCTION. LEONIDA L. RINALDI, SOMERVILLE, MASS.

*Claim.*—1. A submarine construction comprising building-blocks of concrete and arranged in superimposed layers, the ends of adjacent blocks in a layer having interlocking tongues and grooves extending from top to bottom of the blocks, and piles secured in and projecting downward from the bottom of the blocks forming the lowermost foundation layer. Five claims.

728,330. SEA ANCHOR. JOSEPH TEMPERLEY, LONDON, AND JOHN R. TEMPERLEY, BROMLEY, ENGLAND, AND THOMAS S. MILLER, SOUTH ORANGE, N. J.

*Claim.*—1. A sea anchor or drag comprising a series of retarding members attached one behind the other and a steering



surface extending substantially in the line of draft. Twelve claims.

728,553. NAVIGATIONAL SOUNDING APPARATUS. JOHN C. DOBBIE, GLASGOW, SCOTLAND.

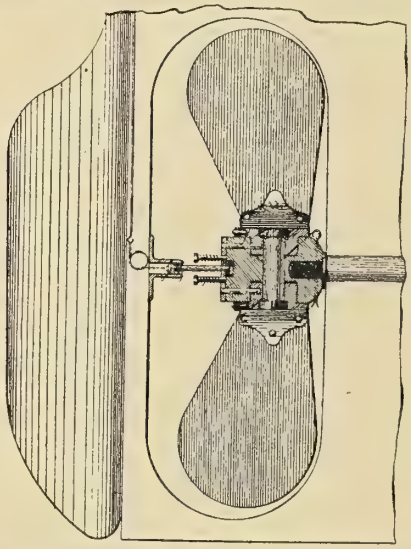
*Claim.*—1. Navigational sounding apparatus composed of a tubular casing closed at one end by a removable fluid-tight cover and furnished with an inlet tube having at its inner end a non-return valve formed by a rubber sleeve fitted over orifices in said tube.

2. In navigational sounding apparatus the combination with the water inlet of a non-return valve consisting of a tubular stem closed at one end and having a series of holes communicating with its central bore, these holes being covered by a rubber sleeve between which and the outer surface of the stem the water passes to the sounder casing. Five claims.

728,576. APPARATUS FOR PREVENTING THE RACING OF MARINE ENGINES. EDWARD HOPE, CHRISTCHURCH, NEW ZEALAND.

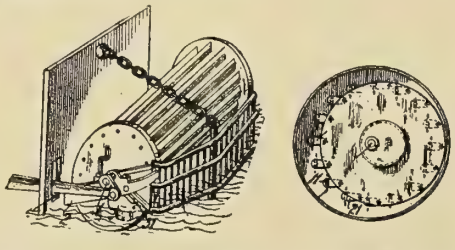
*Claim.*—2. In apparatus for preventing the racing of marine engines provided with a valve, a spindle having a spherical end, a pendulum having a hemispherical top the center of which is coincident with the center of the spherical end of the spindle, parallel ridges on the periphery of the said top gearing with a toothed wheel, and a recess in the pendulum top to receive the said spherical end of the hooked spindle. Five claims.

728,925. PROPELLER. EILT S. JACOBS, NEUHARLINGERSIEL, GERMANY.



*Claim.*—1. A propeller having blades mounted rotatably about an axis perpendicular to the shaft and unsymmetrically shaped with respect to their axis of rotation so as to automatically move under the water pressure; in combination with mechanism by means of which the blades may be secured either in line with the longitudinal perpendicular plane of the ship or in any position assumed upon rocking the blades about their axis. Three claims.

729,397. PROPELLER WHEEL. JOHN W. NOWAK, ALLEGHENY, PA.



*Claim.*—1. A device comprising in combination with a drive shaft, disks mounted thereon, blades or paddles journaled therein, stationary eccentrics carried by the shaft bearings, loosely-mounted disks carried by said eccentrics and connected with said paddles, and means for closing the first-named disks to enclose said eccentrics and loosely-mounted disks. Two claims.